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MOTOR CHARACTERISTICS OF THE MENTALLY RETARDED.

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SCIENTIFIC DATA WERE OBTAINED ON THE MOTOR LEVELS OF ATTAINMENT AND/OR POTENTIALS OF THE MENTALLY RETARDED TO PROVIDE SCIENTIFIC BASES UPON WHICH TEACHERS MIGHT PREPARE FOR FUTURE RESPONSIBILITIES WITH MENTALLY RETARDED PERSONS. THE MAJOR OBJECTIVE WAS TO DETERMINE THE MOTOR CHARACTERISTICS OF THE MENTALLY RETARDED (IQ'S BELOW 80). THE MENTALLY RETARDED CHILDREN INCLUDED IN THIS INVESTIGATION WERE MARKEDLY INFERIOR IN ALL MOTOR PERFORMANCE TESTS AND WITH ADVANCING AGE LEVEL THE DEVIATIONS FROM THE NORMAL TENDED TO BECOME GREATER. HOWEVER, THE GENERAL PATTERN OF CHANGE BY AGE AND SEX WAS SIMILAR TO THAT REPORTED ON NORMAL CHILDREN, AS WERE THE INTERCORRELATIONS AMONG THE SPECIFIC MOTOR TESTS. ALTHOUGH THE FINDINGS WOULD INDICATE THAT THE POOR QUALITY OF MOTOR PERFORMANCE WAS A FUNCTION OF LOW INTELLIGENCE, THE RELATIONSHIP OF MEASURES OF INTELLIGENCE TO THE MOTOR PERFORMANCE TEST SCORES WERE SIMILAR TO CORRELATIONS OBTAINED BETWEEN THESE VARIABLES ON NORMAL HUMANS. THE GREAT DIFFERENCE IN MOTOR PROFICIENCY BETWEEN THE NORMAL AND THE MENTALLY RETARDED AS DEMONSTRATED CLEARLY SHOWS THAT THE DEGREE OF MOTOR RETARDATION OF THESE CHILDREN IS PERHAPS GREATER THAN HAD BEEN PREVIOUSLY SUPPOSED. (GC)

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MOTOR CHARACTERISTICS OF THE MENTALLY RETARDED*

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MOTOR CHARACTERISTICS OF THE MENTALLY RETARDED

A considerable body of information is available concerning the physical and mental development of mentally retarded children, but only a limited number of investigators have made observations on the motor characteristics of the slow learning child. It has been a common practice in the past to relegate the slow learner to those aspects of the curriculum which utilize primarily manual pursuits under the assumption that the motor capacities of these children are more nearly normal than their mental powers. While slow learning children do appear to enjoy the more tangible pursuits which involve both small and gross muscle activity, insufficient data are at hand to guide curriculum workers in respect to the motor needs and abilities of mentally retarded children.

The present study was designed to provide information relative to the gross motor abilities of mentally retarded boys and girls of school age with the view to providing objective data on present levels of achievement of these children. While the study was not concerned with investigating problems of motor learning, some indirect evidence of this will be apparent in observing age differences in performance. Although the major part of the study was directed to the mentally retarded child considered as educable in the public schools, some attention was given to institutionalized cases

of an intellectual level below that usually acceptable for a public school education. The latter phase of this investigation was limited in scope and hence exploratory in nature only.

Purpose and Scope of the Study: The purpose of this study was to determine the motor characteristics of mentally retarded children. The investigation was designed to secure data on (1) children classified as slow learners assigned to special classes in the public schools and (2) a smaller group of institutionalized children of very low intelligence. While the major effort of the investigation was directed to observations on the former group, certain data of some significance were obtained on a small sample of institutionalized children. The specific objectives of the study were, of necessity, oriented to the unique characteristics of the two groups. The more specific purposes of the study were as follows:

1. To determine age and sex trends in the motor functions of the mentally retarded believed to be important in the execution of certain basic gross motor skills.

2. To compare the motor achievement levels of the mentally retarded with normative data on normal children.

3. To determine if the interrelationships among gross motor functions of the mentally retarded are different than the interrelationships among those traits for children of normal intelligence.

4. To determine the extent to which the degree of mental retardation is reflected in the motor achievement levels of the slow learner.

5. To devise and evaluate tests of gross motor performance for children of very low intelligence who are in need of institutionalized care.

The subjects for the investigation included 264 mentally retarded children attending the public schools of Madison and Milwaukee, Wisconsin. The I. Q.'s of these children were between 50 and 90 with a chronological age range of 7.5 years to 14.5 years. To this group a battery of 11 motor tests designed to measure strength, power, balance and agility was administered. Normative data on normal school children are available on most of these tests so that a comparison of the motor achievements of the mentally retarded with that of normal children could be made.

Some 24 institutionalized children of low mentality (I. Q.'s from 15 to 50) were also included in the investigation. These children included both Familials and Mongols from the Northern Colony in Chippewa Falls, Wisconsin and the Southern Colony in Union Grove, Wisconsin. For this group tests were selected and modified to meet the motor and mental requirements of these children. In addition some 60 nursery school children in Madison, Wisconsin were tested on these items so that data on normal children of approximately the same mental age as the institutional cases would be available.

Background of the Investigation: Much has been written concerning the relationship between intelligence and motor ability. With normal humans the evidence shows that measures

of intelligence and scores on motor performance tests are not closely related. For example the work of Johnson (10,11) and Miles (19) demonstrated that intelligence is not related to measures of physical skill, the later investigator including observations from early in life to late maturity. Keller (14) using the Johnson skill test found that physical skill increases with chronological age and school grade, but not with mental age or I. Q. Ray (22) reported correlations of .09 to .26 between physical skill and mental achievement for groups of different levels of intelligence with I. Q. ranges of approximately 15 points in each group. It is interesting to note that the highest of these correlations was in the I. Q. range of 81 to 95. Likewise when scores on mental achievement and physical achievement were correlated for the cases in that I. Q. range a positive correlation of .76 was found, the highest for any of the I. Q. categories. This would suggest that relationships between motor functions and intelligence are higher in the low normal range than in I. Q. ranges of higher intelligence.

In devising tests for intelligence of very young children, research workers have routinely fallen back on sensory-motor items. Justification for the use of these tests is based on the fact that early development is largely devoted to the maturation of the sensory-motor mechanism and hence measures of these functions provide valuable clues concerning the development of the adaptive powers of the child. Although Bayley (1)

has pointed out the inadequacies of sensory-motor tests in the prediction of the later mental ability of children, Chronbach (4) states that these tests represent practically the only objective index for evaluating the developmental progress of children.

The fact that general observation of mentally defectives often discloses marked tendencies toward infantile motor behavior has led investigators to give more detailed study to the motor characteristics of the child of low mentality. In describing the motor characteristics of these children, Tredgold (29) points out that while the most pronounced motor deficiency of the mental defective is in the finer hand and finger movements, the grosser functions involving body balance and locomotion are usually clumsy and ungainly also. Tredgold (30) holds the point of view that even with training the mentally defective has difficulty in developing manual dexterity and body balance, and movement tends to remain uncoordinated. On the other hand Sherman (25) believes that mentally retarded children have the capacity to learn the more simple sensory-motor skills as easily as normal children provided they are given the opportunity. In reviewing the work of other investigators, Doll (6) concludes that the evidence points to a deficiency in motor proficiency which is characteristically associated with mental defectiveness.

More recently Sloan (26) presented comparative data on the motor proficiency of twenty feeble minded and twenty

normal children matched by age and sex. The Lincoln Adaptation of the Oseretsky Test of Motor Proficiency (27) was administered to the subjects in both groups. Reliable differences favoring the normal children were found on all six of the subtests of the Oseretsky scale. The author concluded that motor proficiency cannot be considered as an isolated function, but rather as another aspect of the total behavior of the organism. The study clearly indicates that when observations extend beyond the bounds of normality, motor proficiency and intelligence are related. This supports the point of view of most observers that certain minimum levels of intelligence are required if the organism is to perform effectively the sensory-motor tasks common to our culture.

METHOD OF PROCEDURE

Mentally Retarded Children in the Public Schools

General Methodology: The general methodology of the investigation dealing with the mentally retarded children in the schools was directed to (1) obtaining motor performance data on the mentally retarded boys and girls by age and sex so that comparisons could be made with the motor behavior of normal children and (2) providing data for a study of the interrelationships among motor abilities of the mentally retarded. In describing the motor characteristics of mentally retarded children, the investigator utilized for the most part motor performance tests which have been successfully used with normal children for the age range encompassed by this study. The use of measures for which normative data are available permitted comparisons of the performance of the mentally retarded with that of normal children by age and sex. Furthermore previous studies using these tests had evolved standardized procedures for test administration and had indicated the type of ability which the test was designed to measure. The use of tests which have been routinely employed with normal children also permitted the investigator to examine sex differences in performance of the mentally retarded and to determine if such differences were of the same order as the differences observed in the performance of normal children. The magnitude of the differences in performance between age levels

for the mentally retarded as compared to normal children would likewise be facilitated by the use of tests with established norms. Since studies (23) on normal humans have indicated that motor abilities are more specific than general, the specificity of motor functions could also be investigated with the mentally retarded through the use of these measures.

Selection of the Measures: Since only limited observations have been made on the motor proficiency of the mentally retarded through the use of gross motor skill tests, the following guides were employed in the selection of the measures:

1. Tests which sampled different kinds of abilities. Previous work (23) on normal humans has shown that the average intercorrelation among motor tests approximates .30. Therefore care was taken to sample those kinds of abilities which previous research had indicated as being important in predicting overall motor ability--events which involved the elements of strength, speed, power, agility and balance. The run, the jump, and the throw are activities common to the play experiences of all children and with normal children a weighted combination of these events plus a measure of strength has been shown to be a good predictor of "general motor ability."(15)
2. Tests which were easy to administer and simple to score. Since the testing operations were moved from school to school, the test items needed to present

few administrative problems and only a limited amount of equipment.

3. Tests which were simple enough for the slow learner to comprehend.
4. Tests which could be administered under reasonably well standardized conditions.
5. Tests which gave promise of providing high reliabilities with children of below normal intelligence.

The measures which appeared to most nearly satisfy the above criteria and which were used with the mentally retarded children in the public schools are listed in the appropriate categories as follows:

1. Measures of Static Strength:
   a. Dynamometric strength of right grip
   b. Dynamometric strength of left grip
   c. Pulling dynamometric strength
   d. Thrusting dynamometric strength
2. Measures of Running Speed:
   a. 35 yard dash for time
   b. 30 yard dash for time (with 5 yard starting time deducted)
3. Measures of Power or Dynamic Strength:
   a. Vertical jump (jump and reach)
   b. Standing broad jump
   c. Ball throw for distance
4. Balance:
   a. Balance beam (10 feet)

5. Agility:

a. Burpee test (squat thrusts)

b. Agility run

Description of Tests and Testing Procedures: All children were tested individually on each event although ten to fifteen children were brought into the testing area together. Fatigue was reduced by testing all members of the group on one item before moving to the next. In most instances all tests were given to a particular child on one day.

Measures of Static Strength: A Stoetling hand dynamometer was used in testing the strength of grip of the right and left hand and a manuometer of the rectangular type inserted in the frame of a push-pull attachment was employed for measuring the strength of pull and thrust. For all static strength measures the procedures recommended by Jones (12) were followed. Three trials were given on each item and the best of the three efforts was used as the childs strength score.

Measures of Running Speed: Running speed was measured by the time taken to run a distance of 35 yards from a stationary standing position (gross time) and also by the time required to negotiate the last 30 yards of the same run (net time). The administration of the test necessitated two timers, one of whom timed the runner from the signal go until he crossed the 35 yard finish line. The second timer timed the runner from the moment he crossed a point five yards from the start until he crossed the finish line. Signals for starting and

stopping the watches were given by the two timers, one of whom stood at the finish line and the other at a point five yards from the starting position. Two trials on the same day were given to each subject, the best of the two trials being considered as the subjects running speed.

Measures of Power or Dynamic Strength: The vertical jump was administered according to standard directions using the jump and reach method. To motivate the children the body of a giraffe was painted on a large cardboard and the children attempted to touch with the finger tips designated markings on the giraffe's body. The difference between the child's standing reach and the highest point touched in the jump was taken as the measure of the vertical jump. Three jumps were given, the best effort being used as the subjects score.

The standing broad jump was administered on the gymnasium floor and the distances between the take-off mark and the point of landing of the heel nearest the point of take-off was used as the distance jumped. Three trials were given, the best of the three being the subjects score.

In the throw for distance a tennis ball was used for the eight and nine year olds and a standard softball was used with the older children. All children were asked to perform the overarm throw. All throws were made from a point behind a restraining line, the subjects using a single step in executing the throw (the hop and step prior to the throw was not permitted). The distance was measured by steel tape from the

restraining line to the point at which the ball first struck the ground. Three trials were given and the distance of the farthest throw was used as the score.

Measure of Balance: A ten foot balance beam with a breadth of 1 5/8 inches, top surface nine inches from the floor, was used in the measurement of dynamic balance. The child was asked to walk the beam heel-to-toe, a distance of ten steps. A score of ten was given for executing the distance with no step offs. If the child stepped off the beam prior to completing the ten steps, he was credited with a score equal to the number of steps he had completed prior to the step off. Two trials were given on the balance beam, the best effort being recorded as the score.

Measures of Agility: The squat thrusts were administered according to procedures described by McCloy (15). The children were given a demonstration of the technique and in many instances several trials were needed before many of the subjects were able to perform the movements correctly. This test seemed to be the most difficult one for the largest number of subjects to comprehend and execute and for some children appeared to be as much a test of understanding as of agility. The validity of the test therefore is open to question for slow learning children.

The agility run was devised as a measure of bodily orientation involving the skills of quick rising, quick starting, quick stopping and rapid acceleration in the run. The subject

started the test from the supine position on the floor. At the signal go the subject rose as rapidly as possible traversed a distance of 20 feet picked up a small ball on a table and ran back to the starting line as rapidly as possible. The subjects score was the time in seconds from the signal go until he returned to the starting point. Two trials were given, the best being used as the subject's score.

Description of the Sample: No attempt was made to draw a random sample of mentally retarded children from the Madison and Milwaukee school systems. All physically normal children in special classes for slow learners in two Madison schools were included in the study. This constituted a group of 69 children, 41 boys and 28 girls. In Milwaukee, children from special classes of 11 schools were included in the study comprising two groups of 215 children, 140 boys and 75 girls.

Means for height, weight, chronological age and I. Q. are given in Tables 1 and 2. In comparing the mean heights and weights of the boys and girls included in the sample with published norms (28) on Iowa school children, the means for the children under observation at each age level approximated the figures for the Iowa children. The mean I. Q. of the boys was highly similar from one chronological age to another ranging between 68 and 70. With the girls the I. Q. range was slightly greater falling in the range 64 to 70.

Reliabilities of the Measures: As mentioned earlier the accepted performance score for each child on a particular

Table 1. Means and Standard Deviations of Age, Height, Weight, and I. Q. of Mentally Retarded Boys

Chron. Age	N	Age (years)		Height (inches)		Weight (pounds)		I. Q.	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
8	15	8.1	.36	50.9	3.05	68.3	21.75	70.3	8.07
9	30	9.0	.39	52.2	2.56	65.0	10.09	69.6	10.36
10	31	9.9	.35	54.0	3.49	73.7	13.92	70.2	7.22
11	26	11.0	.39	57.1	4.12	84.0	19.57	69.1	7.26
12	24	11.9	.34	58.0	3.65	88.4	22.74	68.6	7.99
13	28	12.9	.32	61.5	2.87	101.7	20.10	69.2	8.09
14	27	13.9	.37	62.7	4.70	110.2	28.67	68.2	10.25

Table 2. Means and Standard Deviations of Age, Height, Weight, and I. Q. of Mentally Retarded Girls

Chron. Age	N	Age (years)		Height (inches)		Weight (pounds)		I. Q.	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
8	12	8.0	.40	50.5	3.41	58.1	11.87	64.3	5.80
9	22	9.1	.29	53.2	3.19	66.8	15.29	66.2	7.34
10	13	9.8	.28	54.4	2.29	81.2	14.27	69.9	5.46
11	12	11.0	.32	59.0	3.16	84.8	15.55	69.7	9.95
12	15	12.0	.35	58.0	3.35	91.5	19.55	69.7	7.69
13	15	13.0	.37	60.4	3.57	111.4	31.93	65.9	6.28
14	14	13.9	.33	61.6	3.17	103.5	16.75	64.6	6.42

event was the best of the two or three trials administered. In those events where three trials were given, the best performance score was correlated with the average of the other two. Where only two trials were given the best score was correlated with the other score.

Static Strength Measures: The reliability coefficients of the four static strength measures classified according to sex and age are given in Table 3. Correlation coefficients were obtained by correlating the best score with the average of the other two trials. All coefficients were above .857 which clearly shows that the mentally retarded children were capable of performing reliably on this type of strength measure. The reliabilities obtained here differ little from those obtained by Jones (12) on the same measures given to adolescent children in which reliabilities ranging from .932 to .964 were reported. It should be noted in Table 3 that neither chronological age nor sex appeared to affect the reliability of the static strength measures.

Measures of Dynamic Strength: The standing broad jump, the vertical jump and the throw for distance have been shown to be highly reliable measures when used with normal children. It should be noted in Table 4 that these measures (best trial with the average of the other two) when used with the mentally retarded children likewise gave high reliability coefficients for both boys and girls at each age level. Only two of the 42 coefficients were below .928, the broad jump with the

Table 3. Reliability Coefficients for Measures of Static Strength for Mentally Retarded Boys and Girls

Chron. Age	Boys				Girls			
	Right Grip	Left Grip	Pull	Thrust	Right Grip	Left Grip	Pull	Thrust
8	.955	.971	.951	.960	.960	.944	.934	.964
9	.910	.919	.950	.972	.925	.976	.865	.909
10	.954	.857	.955	.962	.933	.896	.943	.970
11	.951	.975	.967	.978	.974	.963	.961	.964
12	.949	.966	.967	.977	.928	.936	.969	.995
13	.978	.990	.974	.984	.979	.981	.996	.987
14	.980	.989	.970	.958	.960	.972	.966	.962

Table 4. Reliability Coefficients for Measures of Dynamic Strength for Mentally Retarded Boys and Girls

Chron. Age	Boys			Girls		
	Broad Jump	Vertical Jump	Throw for Distance	Broad Jump	Vertical Jump	Throw for Distance
8	.992	.976	.980	.985	.965	.934
9	.977	.976	.986	.982	.981	.951
10	.954	.954	.992	.987	.981	.966
11	.975	.954	.981	.991	.947	.972
12	.972	.980	.972	.984	.939	.995
13	.812	.928	.988	.977	.708	.989
14	.970	.969	.978	.966	.935	.992

thirteen year old boys being .812 and the vertical jump with the thirteen year old girls being .708. On the basis of the coefficients reported here the mentally retarded children performed with acceptable reliability on the tests of dynamic strength.

Measures of Running Speed: Since only two trials were given in this event, the reliability coefficients shown in Table 5 were obtained by correlating the best score with the score on the other trial. The scores used were the fastest times required to run the 35 yards and 30 yards respectively. The reliabilities obtained with the mentally retarded children compare favorably with those reported by Espenschade (7) on normal children. It should be noted in Table 5 that the boys performed more reliably than the girls with coefficients ranging from .916 to .988 whereas with the girls four of the fourteen coefficients were below .90. At the older age levels (13 years and 14 years) three of the four reliabilities for girls were below .90 which suggests that reliability of performance in the dash may in part be a function of chronological age with mentally retarded girls just as it is with normal girls. Espenschade (7) reported problems of motivating adolescent girls particularily in the dash. The children seemed to perform just as reliably in the 35 yard dash as they did in the 30 yard dash where the starting time (time for the first five yards) was deducted.

Measures of Balance and Agility: The reliability coefficients for the measures of balance and agility grouped according to chronological age and sex are shown in Table 6. The reliabilities in each instance were obtained by correlating the best score against the other trial. This group of events produced the lowest reliabilities of the battery of tests administered. In the case of the balance beam test this was perhaps due to the scoring system utilized which restricted the range of scores to a maximum of ten and forced the clustering of scores to a narrow range at given age levels. Even so the reliabilities for this event ranged from .669 to .999, which permitted the use of the scores for group analysis. In the case of the squat thrusts the reliability of the score was affected in part by the difficulty many of the children had in correctly executing the event which introduced considerable subjectivity in scoring. Had more time been available to help the children learn the technique, the reliabilities would probably have been higher. As will be noted the girls performed quite reliably in this test only one of the correlation coefficients falling below .911. In the case of the boys five of the correlations ranged from .726 to .892. The agility run proved to be more reliable than the other two events with 10 of the 14 coefficients being above .90.

Table 5. Reliability Coefficients for Speed of Running for Mentally Retarded Boys and Girls

Chron. Age	Boys		Girls	
	35 Yd. Dash	30 Yd. Dash	35 Yd. Dash	30 Yd. Dash
8	.979	.987	.955	.993
9	.925	.928	.953	.979
10	.936	.916	.966	.977
11	.962	.981	.880	.959
12	.957	.977	.947	.947
13	.934	.988	.864	.932
14	.955	.983	.793	.808

Table 6. Reliability Coefficients for Measures of Balance and Agility for Mentally Retarded Boys and Girls

Chron. Age	Boys			Girls		
	Balance Beam	Squat Thrust	Agility Run	Balance Beam	Squat Thrust	Agility Run
8	.963	.978	.956	.814	.922	.976
9	.753	.934	.970	.823	.911	.964
10	.864	.881	.919	.799	.801	.954
11	.669	.892	.928	.999	.923	.676
12	.794	.865	.951	.707	.919	.972
13	.812	.776	.830	.960	.955	.887
14	.785	.726	.912	.851	.931	.877

Procedures Used with the Institutionalized Cases

The problems encountered in testing the children in the I. Q. range 15 to 50 necessitated restricting the size of the sample to be studied. Much of the work had to be done on a trial and error basis and considerable time and energy were devoted not only to gaining the confidence of the child, but in experimenting with procedures which the child could comprehend and which would appear to give reasonably valid and reliable results. The final sample upon which most of the data are based included a total of 24 cases, 15 Mongols, 8 Familial and one unclassified case. The chronological age of the group averaged approximately 10 years with an I. Q. range of 15 to 50. In addition to these children a group of 60 normal preschool children in the age range 1½ to 5½ years was tested so that normative data would be available for comparative purposes.

Selection of Test Items: The original plan of the investigation was to select tests which would measure those types of gross motor skills which are usually acquired prior to the time the normal child reaches school age. In general these skills might be called "self-sufficiency skills" in that the young child acquires most of these abilities as he works and experiments in the environmental setting. These skills have been termed the "racial skills" in that most human beings acquire them to varying degrees early in life. Therefore an

attempt was made to devise tests which would measure such motor functions as strength, speed, agility, power, balance, flexibility, rhythm, and fine motor coordination. A battery of some 20 test items was developed which proved to be usable with the sample of nursery school children. However, many of these tests proved to be too difficult for the institutionalized cases to perform or in many instances to comprehend. As a result the original battery of 20 items was reduced to the following six tests:*

1. Agility run
2. Target throw
3. Pennies-in-the-box
4. Striking with a mallet
5. Stair climbing
6. Grip strength

Description of the Sample: In selecting institutionalized cases for study no attempt was made to obtain a random sample. Since this phase of the study was largely exploratory in nature and was not concerned primarily with making inferences to larger populations of children in the lower range of intelligence, randomizing the sample was not essential. However, care was taken to exclude children with obvious physical defects. The chronological age range extended from seven to twelve years with the mean age of the Familials 10.1 years

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*For a description of the administration of these tests see Appendix B.

and that of the Mongols 9.3 years. The chronological age, I. Q. and classification of the 24 cases are given below.

Subject Number	Chron. Age	I. Q.	Classification
1	7	38	Unclassified
2	9	40	Familial
3	9	--	Familial
4	10	45	Familial
5	10	47	Familial
6	11	43	Familial
7	11	45	Familial
8	12	49	Familial
9	12	--	Familial
10	7	31	Mongol
11	7	--	Mongol
12	7	--	Mongol
13	8	30	Mongol
14	8	30	Mongol
15	9	47	Mongol
16	9	37	Mongol
17	9	15	Mongol
18	9	--	Mongol
19	10	50	Mongol
20	10	22	Mongol
21	11	27	Mongol
22	11	28	Mongol

Subject Number	Chron. Age	I. Q.	Classification
23	12	20	Mongol
24	12	--	Mongol

Method of Treating Data: Since the number of cases was limited and since the data were not complete for all tests on all 24 cases only a generalized treatment of the data seemed feasible. The technique involved the use of measures of central tendency to compare the performance level of the institutionalized cases with that of nursery school children.

FINDINGS OF THE STUDY

In presenting and discussing the findings of the study, the material has been organized under five headings, namely: (1) age and sex trends in motor proficiency; (2) comparisons of motor proficiency of normal and mentally retarded children; (3) interrelationships among gross motor functions of the mentally retarded; (4) relationship of I. Q. to motor performance of the slow learner; and (5) presentation of motor performance data and suggested motor tests for institutionalized children of very low intelligence.

Age and Sex Trends in Motor Proficiency

Static Dynamometric Strength: The data on right and left grip strength grouped according to chronological age for both sexes are given in Table 7. It should be noted that both right and left grip strength improve with age. The greater increments in strength between the twelfth and the thirteenth year are indicative of approaching puberty which is also reflected in the increases in body weight for both sexes at this age level. At each age level the boys on the average are stronger in both right and left grip than the girls. This coincides with the findings of other studies on normal children at these age levels (12,16,17). For the boys the right hand is stronger at each age level than is the left, whereas with the girls at two age levels the left hand is the stronger.

These data are somewhat different than that reported on normal humans in which it has been shown that right grip is about 12 per cent stronger than the left in girls and only about 6 per cent stronger in boys (12).

The data on strength of pull and thrust for the mentally retarded boys and girls are presented in Table 8. The same pattern of increase in strength as was observed in gripping strength is seen in the case of both pull and thrust for boys, a rather constant increase in strength by chronological age up to age twelve and then a marked increment in strength. For girls this pattern does not hold, for maximum strength in both pull and thrust appear to be achieved at approximately twelve years of age, followed thereafter by little if any change. For boys thrusting strength is higher at every age level than pulling strength, whereas with girls the differences are slight and do not consistently favor either pull or thrust. It is interesting to note that Jones (12) found with normal girls a tendency for strength of pull and thrust to continue to increase through the years twelve, thirteen, and fourteen.

Dynamic Strength: The application of maximum muscular effort in propelling the body or body segments with maximum velocity in a single burst of activity is generally held to be a measure of dynamic strength or power. Jumping performance and power throws have frequently been used to measure dynamic strength. It should be recognized that these skills require more than a simple application of muscular force, since

Table 7. Means and Standard Deviations of Grip Strength of Mentally Retarded Boys and Girls

Chron. Age	Grip Strength Right (in Kg.) Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Grip Strength Left (in Kg.) Boys Mean	Boys S.D.	Girls Mean	Girls S.D.
8	13.4	3.42	7.8	2.42	12.1	3.56	7.6	2.85
9	14.4	3.45	12.3	3.90	13.0	3.20	12.0	3.19
10	15.6	3.45	12.3	3.04	14.1	2.99	12.5	3.12
11	17.7	4.62	17.1	4.13	16.7	4.75	15.7	4.27
12	18.6	4.97	17.9	3.90	17.5	4.77	16.9	3.98
13	24.0	6.68	18.9	4.87	23.7	6.93	18.6	4.97
14	26.4	8.66	22.2	5.49	24.8	7.70	22.9	5.17

Table 8. Means and Standard Deviations of Strength of Pull and Thrust of Mentally Retarded Boys and Girls

Chron. Age	Pull (in pounds) Boys Mean	Boys S. D.	Girls Mean	Girls S. D.	Thrust (in pounds) Boys Mean	Boys S. D.	Girls Mean	Girls S. D.
8	22.4	8.02	14.8	5.37	24.5	9.89	14.8	6.15
9	27.3	9.62	24.1	5.59	29.9	11.95	21.4	7.03
10	31.0	8.40	23.0	7.36	33.6	11.57	24.4	9.04
11	36.4	8.69	30.6	10.21	38.5	14.11	28.9	10.40
12	34.5	12.02	34.4	10.00	40.2	15.54	35.0	13.23
13	44.6	13.68	34.9	11.46	52.2	18.41	33.7	15.54
14	48.5	14.16	33.4	12.18	55.9	17.10	33.7	15.69

the skills of jumping and throwing require the coordination and proper timing of many body segments. Therefore performance of these skills is in a large measure a reflection of previous experience in activities involving these skills.

Means and standard deviations of performance in the standing broad jump and the vertical jump for boys and girls are shown in Table 9. It will be noted that the boys excelled the girls in both jumping skills at six of the seven age levels. With normal children boys on the average are superior at every age level. The changes in performance scores with increasing chronological age is not what one usually sees with normal children. With the subjects included here the changes in performance scores in the standing broad jump do not show a regular and gradual increase with chronological age as is typical with normal children, nor are these increments of as great a magnitude. For example, Kane and Meredith (13) found that between seven and nine years of age boys showed an increase in mean broad jumping performance of 8.2 inches and an increase of 10 inches between nine and eleven years. For the mentally retarded boys there was no change in performance between eight and ten years and a gain of only about three inches between 10 and 12 years. It should be noted that the greatest age difference in broad jump performance for boys was observed between the ages 12 and 13 which followed the pattern of change noted in static strength. It should be noted also that between ages 9 and 14 the age difference in performance for girls was

only three inches as compared to differences of approximately 14 inches reported by Kane and Meredith for normal girls between the ages of seven and 11 years. In the vertical jump the sex differences are of the same order as for normal children, although the scores for both sexes are markedly lower than the performance levels of children of normal intelligence.

The data for the distance throw by age and sex are given in Table 10. It will be noted that the boys were superior to the girls at every age level which follows the typical pattern for normal children. The approximately two to one superiority of the boys at age 14 is similar to that reported by Espenschade (7). Age trends for both sexes show a rather consistent yearly difference with the performance of boys reaching a plateau at 13 years of age and the girls showing a decline after this age level. The stabilization or decline of performance in the throw at this age level is typical of normal girls, but normal boys continue to show improvement in the throw during the adolescent years.

Speed of Running: Mean times for performance in the 35 yard dash for both sexes at each age level are given in Table 11. With advancing age improved performance for both sexes may be observed between most age levels. Perhaps the best indication of running speed is provided by examining the data for net time for thirty yards which excludes reaction time of the performer at the start and the time required for acceleration

Table 9. Means and Standard Deviations of Dynamic Strength Measure of Mentally Retarded Boys and Girls

Chron. Age	Broad Jump (in inches)				Vertical Jump (in inches)			
	Boys		Girls		Boys		Girls	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
8	36.7	14.20	18.4	11.77	6.9	2.78	3.8	2.44
9	33.4	13.22	35.0	11.58	7.6	2.39	6.9	2.52
10	36.6	11.71	29.7	12.79	7.1	2.24	6.4	2.06
11	40.5	10.76	34.7	15.09	8.4	2.24	8.5	2.10
12	39.1	10.38	35.8	10.60	8.4	2.87	8.2	1.73
13	45.7	9.73	38.1	10.58	9.9	2.05	8.8	1.24
14	44.7	14.92	38.3	9.98	11.0	3.95	8.5	2.76

Table 10. Means and Standard Deviations of Ball Throw for Distance Measures of Mentally Retarded Boys and Girls

Chron. Age	Softball Throw (in feet)				Tennis Ball Throw (in feet)			
	Boys		Girls		Boys		Girls	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
8					41.0	15.20	19.0	6.55
9					53.2	24.10	31.3	10,51
10	55.8	23.47	33.9	22.33				
11	66.9	21.57	36.5	16.48				
12	71.3	26.70	50.4	20.96				
13	93.4	32.70	61.0	17.94				
14	92.4	29.12	47.4	20.49				

during the first five yards of the run. With this as a measure of running speed, the boys show progressively faster times with advancing age whereas the performance for the girls is less regular with increasing age. For example, the performance of girls at age nine was better than would be expected on the basis of the mean performance at ages 8 and 10 years. It should be recalled that the number of cases of girls at the lower age levels is small and chance may have introduced a disproportionate number of good performances at this age level. High performance of girls at this age level was also noted in the jumping events which suggests a clustering of motor talent within this age group.

Balance Beam Performance: Studies of body balance in children have been directed primarily to the study of (1) the ability of children to maintain balance in a stationary position on one foot (static balance) and (2) the ability of children to maintain balance while moving (dynamic balance). Most authorities agree that positioning of the body while in motion is more closely related to the kinds of balance required in most of the physical skills of childhood. Hence in the present investigation a balance beam was employed as a measure of dynamic balance. Mean scores of boys and girls by chronological age are shown in Table 12. The scores represent the average number of steps taken before the subject stepped off the beam. In general, performance for both boys and girls shows an increase with advancing age, the boys being superior at

Table 11. Means and Standard Deviations of Performance Times of Mentally Retarded Boys and Girls in the 30 and 35 Yard Dashes

Chron. Age	35 Yard Dash (gross time in seconds) Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	30 Yard Dash (net time in seconds) Boys Mean	Boys S.D.	Girls Mean	Girls S.D.
8	7.2	1.11	9.6	1.37	5.8	.85	7.7	1.38
9	7.3	.90	7.6	1.02	5.8	.78	6.1	.88
10	7.1	.84	8.0	.78	5.7	.70	6.2	.84
11	6.9	1.05	6.7	.57	5.5	.84	5.4	.51
12	6.4	1.57	7.2	1.10	5.1	1.21	5.8	.94
13	6.3	.86	6.7	.70	4.9	.75	5.2	.59
14	6.1	.74	6.5	.70	4.8	.69	5.1	.77

Table 12. Means and Standard Deviations of Balance Beam Performance of Mentally Retarded Boys and Girls

Chron. Age	Balance Beam (no. of steps) Boys Mean	Boys S.D.	Girls Mean	Girls S.D.
8	8.1	3.18	5.8	3.34
9	8.1	3.14	8.1	3.18
10	7.9	2.97	7.1	3.34
11	8.8	2.58	7.5	.70
12	8.3	2.98	8.5	2.70
13	9.4	1.99	8.7	2.67
14	9.1	2.29	7.8	2.88

most age levels. Studies of balance beam performance by Seashore (24) has shown that there is a gradual increase in performance from 7 years to 12.5 years, then a slight decline during early adolescence. With the mentally retarded group investigated here, the decline in performance in both sexes occurred at age 14. Espenschade (8) reported that adolescent boys show a reduction in gain in performance on beam walking tests in the years 13 to 15, which the investigator attributed to an "adolescent lag" in the development of dynamic balance. It would appear that in this respect the mentally retarded are similar to normal children.

Age and Sex Differences in Agility: Means and standard deviations of performance on the agility run and the Burpee Test are shown in Table 13. It will be noted that improved performance in the agility run occurred with boys as age increased. While a similar trend was noted with the girls, the mean scores at ages 10 and 14 were poorer than at ages 9 and 11 respectively. At each age level the boys were superior in performance to the girls which follows the general trend for agility type runs with normal children. In the Burpee Test (squat thrusts) the boys were superior in performance to the girls at all ages with the exception of the 12 year age level. The trend of performance on the Burpee Test did not show clear cut differences with chronological age which is rather typical of the performance of normal children also.

Table 13. Means and Standard Deviations of Agility Measures with Mentally Retarded Boys and Girls

Chron. Age	Agility Run (in seconds)				Burpee			
	Boys		Girls		Boys		Girls	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
8	6.2	.89	7.5	1.40	3.6	1.04	2.8	.95
9	6.0	1.17	6.3	.99	4.0	1.14	3.7	.90
10	5.9	.65	6.7	.79	4.2	1.04	3.4	.88
11	5.7	.65	6.0	.67	4.0	.74	3.7	.72
12	5.7	.87	5.9	.78	3.7	.98	3.7	1.00
13	5.4	.68	5.8	.70	4.2	1.05	3.6	1.19
14	5.2	.60	5.9	.84	4.4	.98	3.3	.88

Comparison of Motor Proficiency of Mentally Retarded and Normal Children

Static Dynamometric Strength: Since the differences in strength between right and left hands for respective ages are highly similar for both normal and mentally retarded children only the data for right grip has been plotted. (See Figure 1). It will be noted that the general age trends are similar for the normal and mentally retarded children with the exception that at each age level the normal children for a particular sex are materially stronger than the mentally retarded. While the sex difference in manual strength are reasonably large for both groups at each age (ages 11 and 12 in the mentally retarded excepted), it should be noted that normative data on normal girls show a superiority of the normal female over the mentally retarded male at all age levels above nine years. The general slope of the curve for both normal males and females is somewhat greater than that for the mentally retarded, indicating that the slow learning child on the average loses ground in terms of acquiring manual strength. It is also interesting to note that in manual strength the normal eight year old male had gripping strength on the average equal to that of the ten year old slow learner. While the manual strength of the normal eight year old boys was approximately two kilograms greater than the mentally retarded eight year old, the difference was almost 10 kilograms at 14 years of age. Although the differences were in the same direction for the

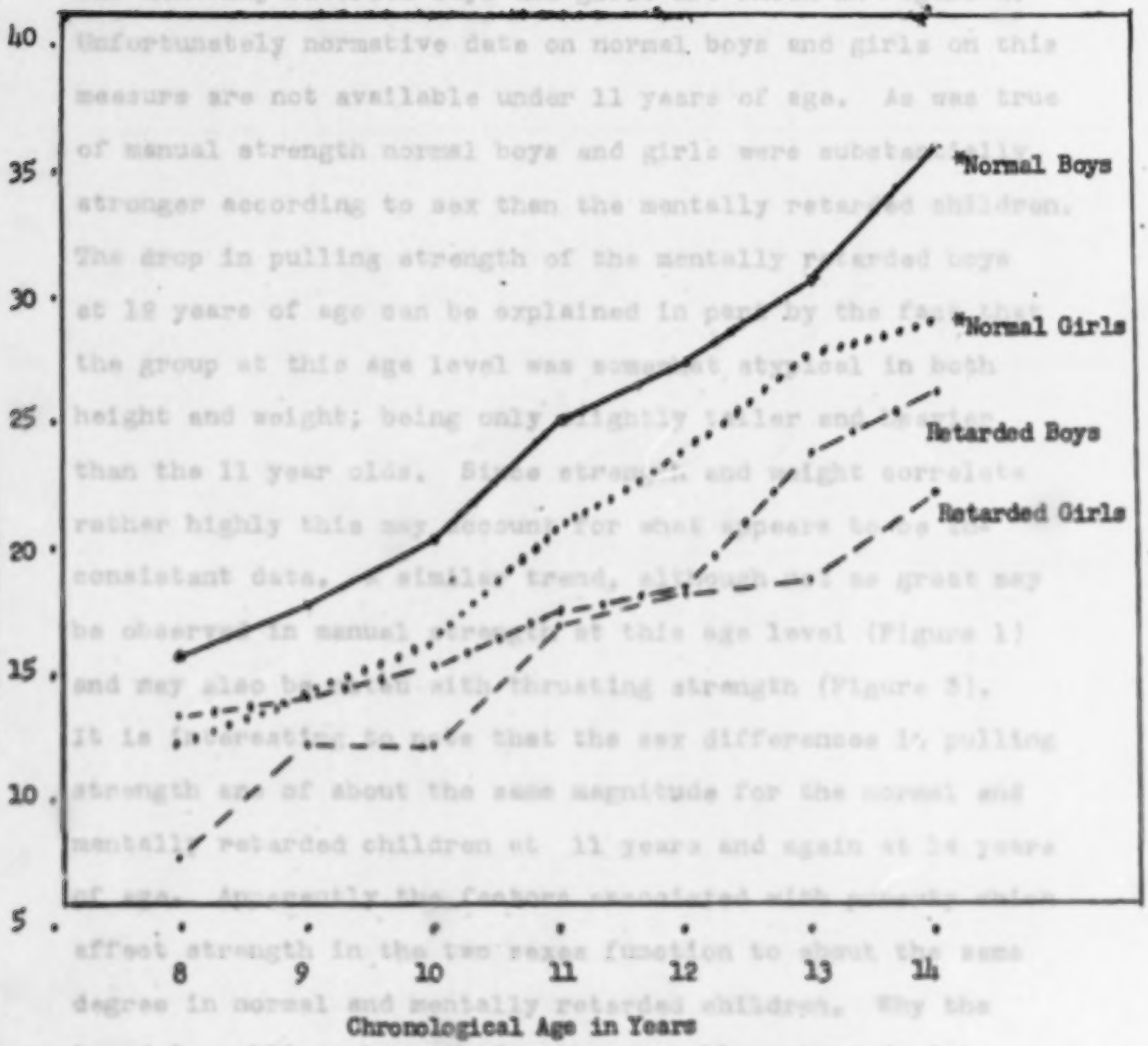

Figure 1 Mean Strength of Right Grip for Normal and Mentally Retarded Boys and Girls

*Data on Normal Boys and Girls Adapted from Meredith (16), Metheny (17), and Jones (12).

girls at these ages, the magnitude of the differences was not so great.

The data on shoulder girdle strength (Pull) for normal and mentally retarded boys and girls are shown in Figure 2. Unfortunately normative data on normal boys and girls on this measure are not available under 11 years of age. As was true of manual strength normal boys and girls were substantially stronger according to sex than the mentally retarded children. The drop in pulling strength of the mentally retarded boys at 12 years of age can be explained in part by the fact that the group at this age level was somewhat atypical in both height and weight, being only slightly taller and heavier than the 11 year olds. Since strength and weight correlate rather highly this may account for what appears to be inconsistant data. A similar trend, although not as great may be observed in manual strength at this age level (Figure 1) and may also be noted with thrusting strength (Figure 3). It is interesting to note that the sex differences in pulling strength are of about the same magnitude for the normal and mentally retarded children at 11 years and again at 14 years of age. Apparently the factors associated with puberty which affect strength in the two sexes function to about the same degree in normal and mentally retarded children. Why the trend in pulling strength for the mentally retarded girls should reach a plateau at 12 years of age and then decline at 14 years cannot be explained. With normal girls the trend

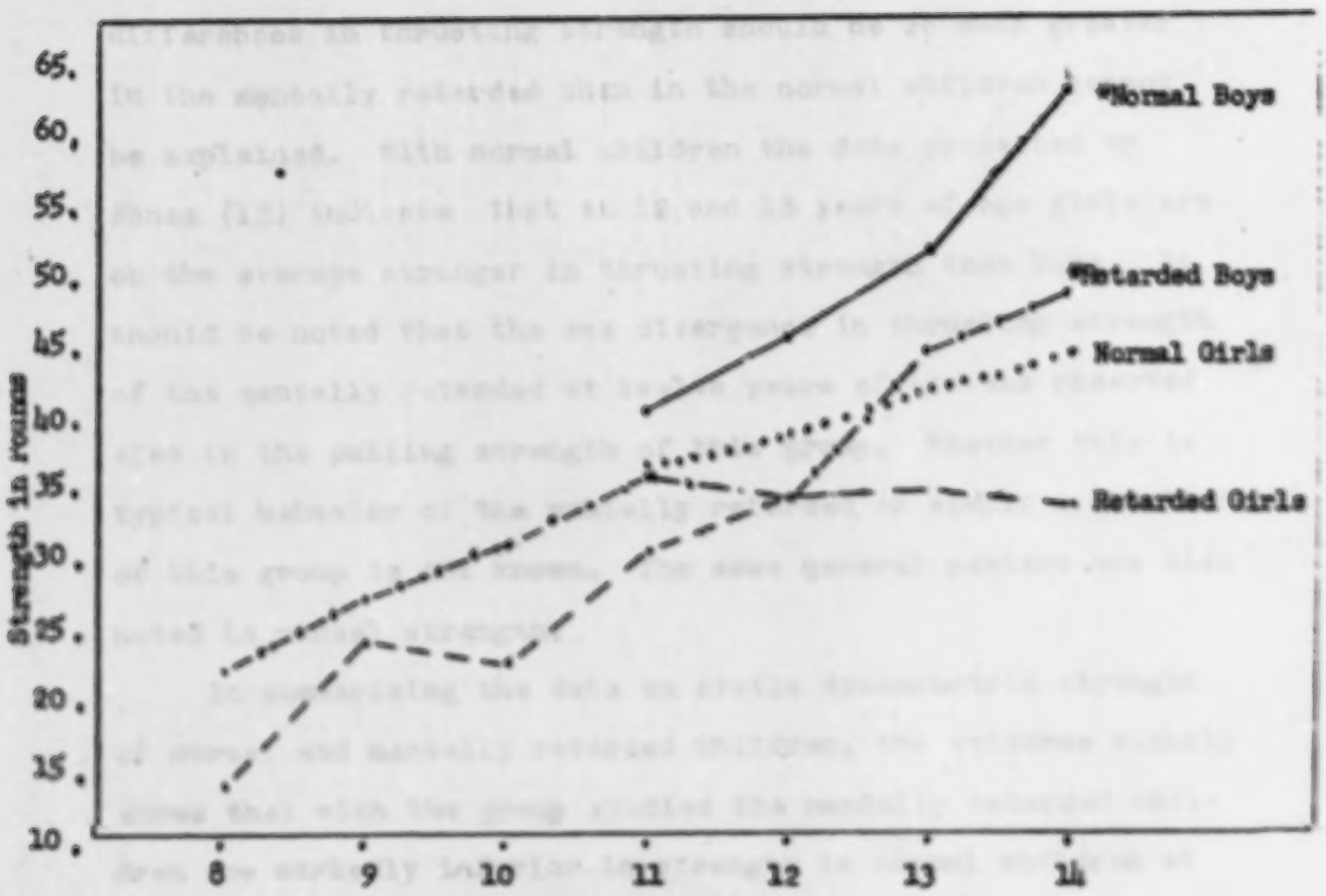

Figure 2. Mean Shoulder Girdle Strength (Pull) of Normal and Mentally Retarded Boys and Girls

*Data on Normal Boys Taken from Jones (12).

continues through 14 years of age with the slope of the curve being approximately the same as that for the three previous years (12).

Age differences in thrusting strength for normal and mentally retarded boys and girls are shown in Figure 3. Here again the normal children are markedly superior at those age levels for which normative data are available. Why the sex differences in thrusting strength should be so much greater in the mentally retarded than in the normal children cannot be explained. With normal children the data presented by Jones (12) indicate that at 12 and 13 years of age girls are on the average stronger in thrusting strength than boys. It should be noted that the sex divergence in thrusting strength of the mentally retarded at twelve years of age was observed also in the pulling strength of this group. Whether this is typical behavior of the mentally retarded or simply a function of this group is not known. The same general pattern was also noted in manual strength.

In summarizing the data on static dynamometric strength of normal and mentally retarded children, the evidence clearly shows that with the group studied the mentally retarded children are markedly inferior in strength to normal children at every age level. In general this inferiority becomes more noticeable with advancing age. The reason for this tendency to lose ground is not readily apparent, but it cannot be due to growth failure, since at almost every age level the mentally

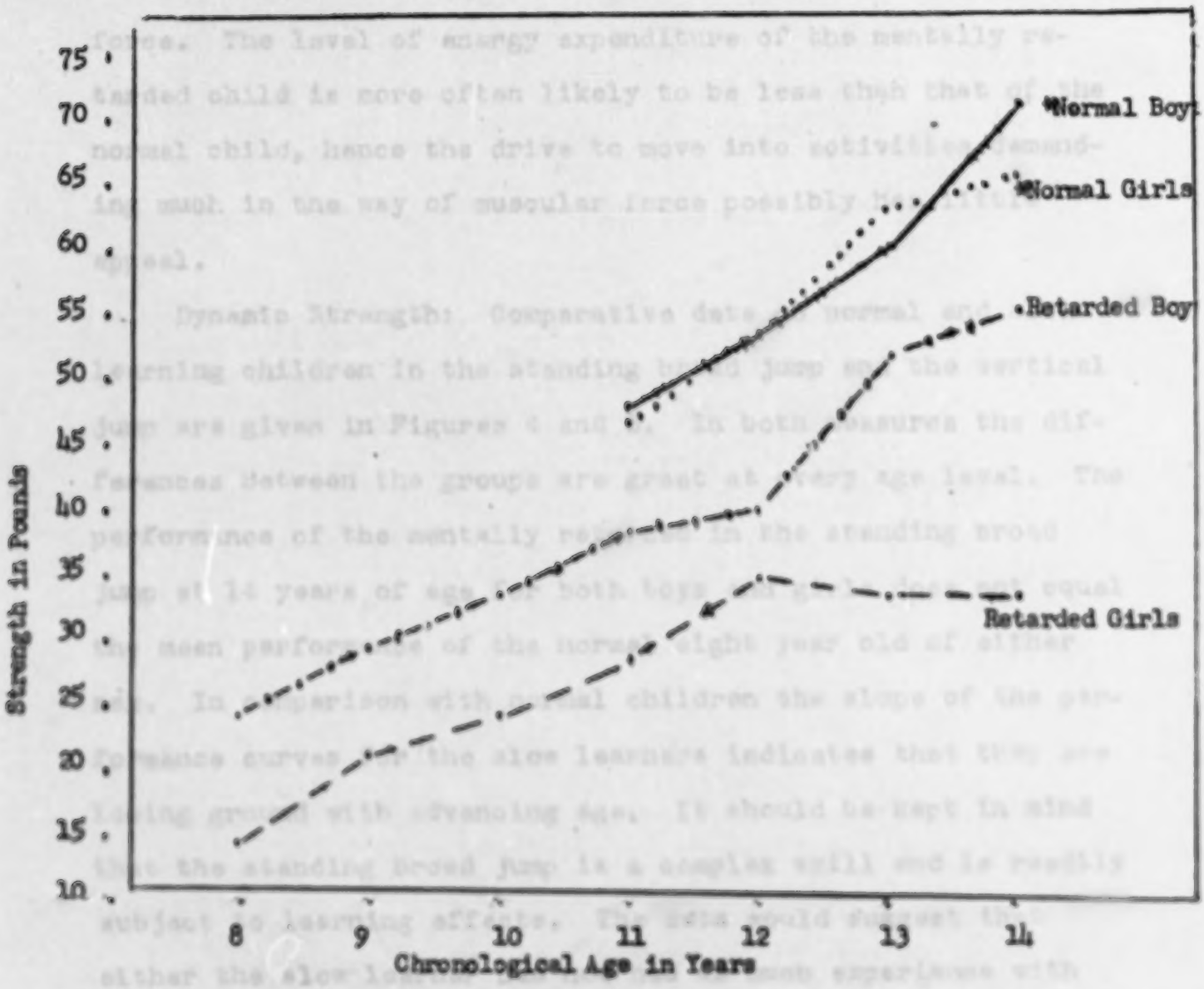

Figure 3. Mean Shoulder Girdle Strength (Push) of Normal and Mentally Retarded Boys and Girls

*Data on Normal Boys and Girls Taken from Jones (12).

retarded children were at or exceeded published height and weight norms. It is more likely due to a tendency for the mentally retarded to use his body less than the normal child in activities which require the development of maximum muscular force. The level of energy expenditure of the mentally retarded child is more often likely to be less than that of the normal child, hence the drive to move into activities demanding much in the way of muscular force possibly has little appeal.

Dynamic Strength: Comparative data on normal and slow learning children in the standing broad jump and the vertical jump are given in Figures 4 and 5. In both measures the differences between the groups are great at every age level. The performance of the mentally retarded in the standing broad jump at 14 years of age for both boys and girls does not equal the mean performance of the normal eight year old of either sex. In comparison with normal children the slope of the performance curves for the slow learners indicates that they are losing ground with advancing age. It should be kept in mind that the standing broad jump is a complex skill and is readily subject to learning effects. The data would suggest that either the slow learner has not had as much experience with this kind of skill as the normal child or that the learnings associated with this skill are too involved for him to readily master. Examination of the data on the vertical jump would perhaps suggest the latter, since the slope of the performance

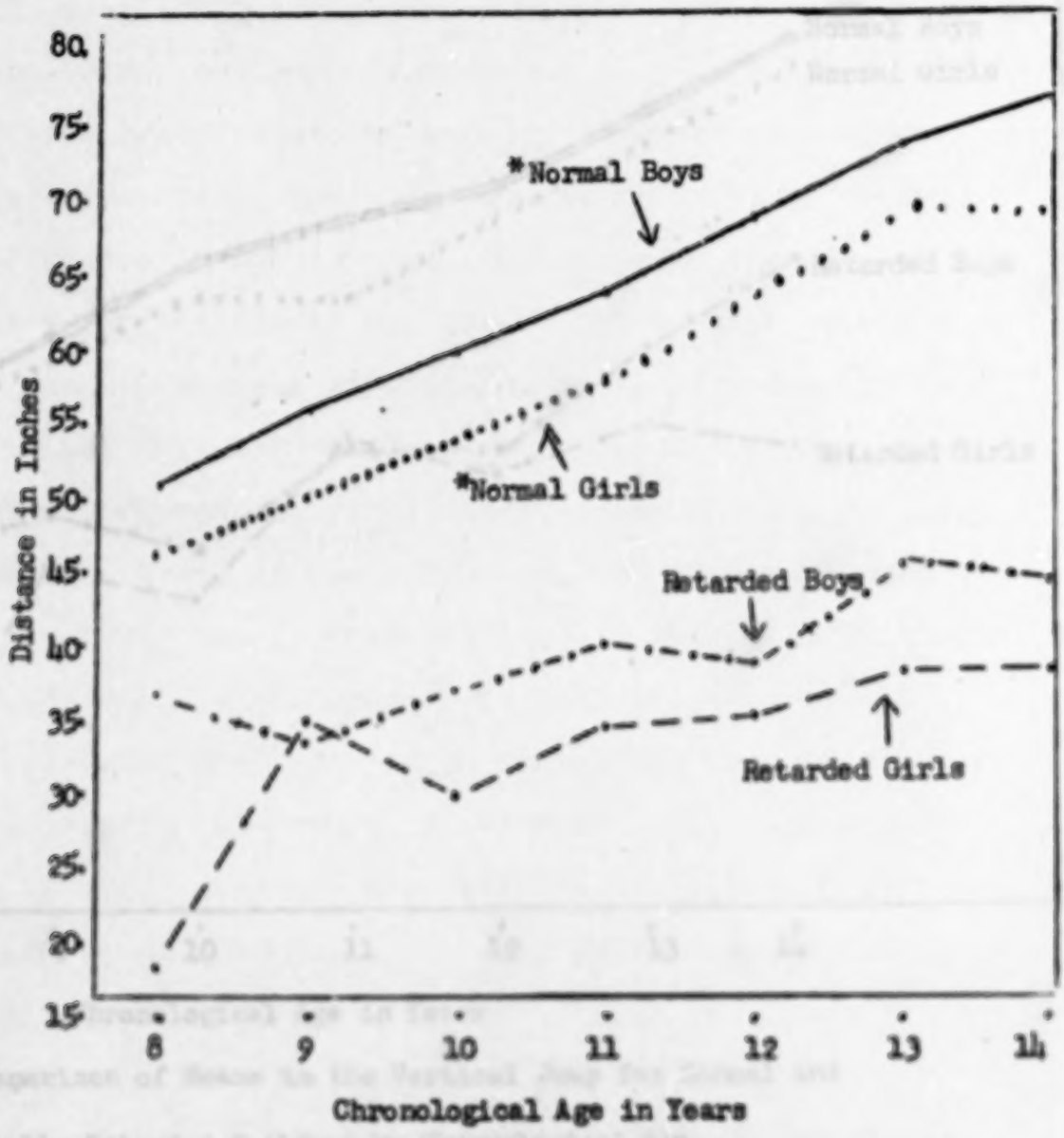

Figure 4. Comparison of Mean Performance Scores in the Standing Broad Jump for Normal and Mentally Retarded Children by Chronological Age.

*Data on Normal Boys and Girls Adapted from Neilson and Cozens (20), Espenschade (7), and the Highland-Mendota Beach Research Project, University of Wisconsin.

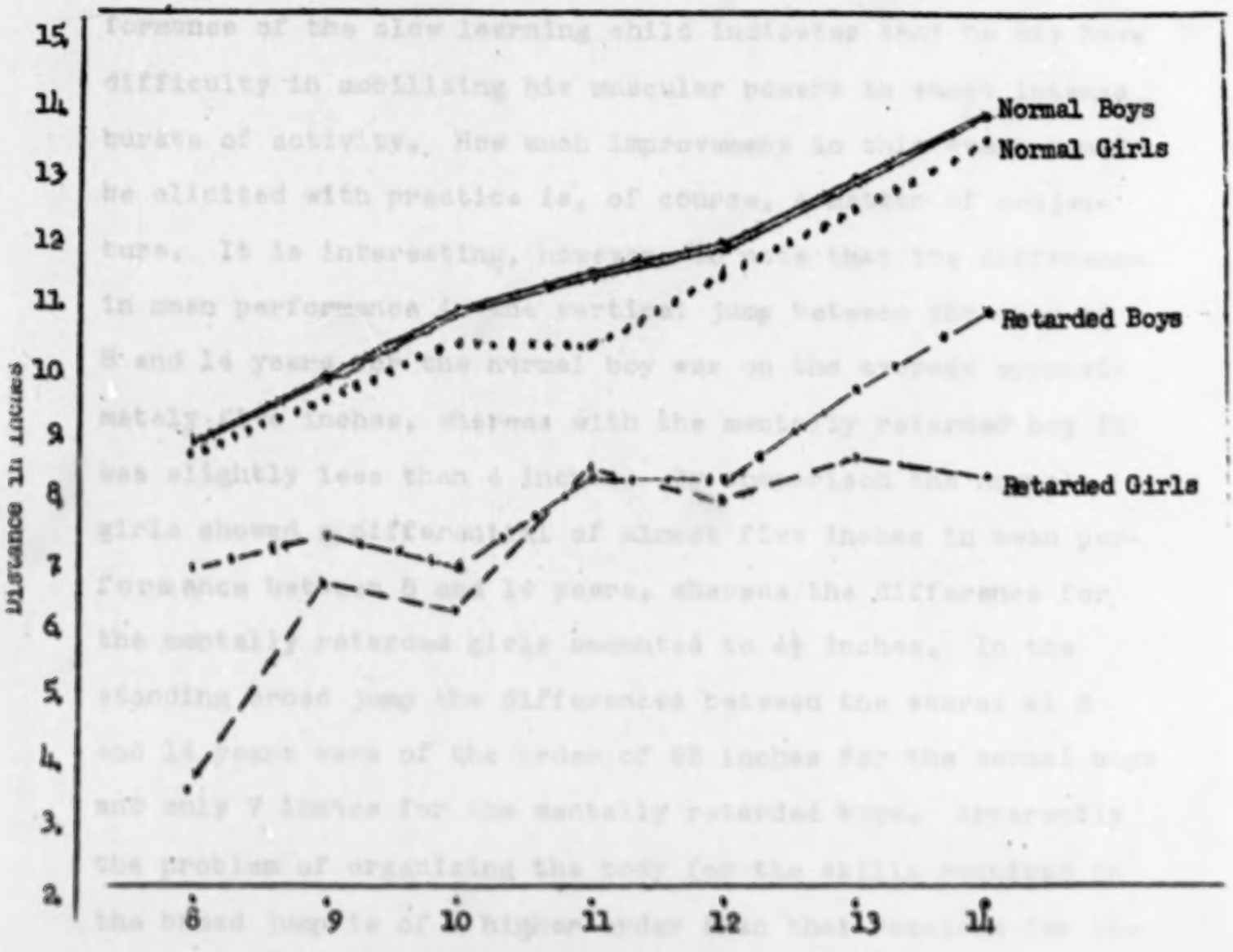

Figure 5. Comparison of Means in the Vertical Jump for Normal and Mentally Retarded Children by Chronological Age

*Data on Normal Boys and Girls Adapted from Moyer (18), McCloy (15) and Neilson and Cozens (20).

curve in this event parallels that of the normal children even though it is substantially lower. The markedly inferior performance of the slow learning child indicates that he may have difficulty in mobilizing his muscular powers in short intense bursts of activity. How much improvement in this event could be elicited with practice is, of course, a matter of conjecture. It is interesting, however, to note that the difference in mean performance in the vertical jump between the ages of 8 and 14 years for the normal boy was on the average approximately five inches, whereas with the mentally retarded boy it was slightly less than 4 inches. By comparison the normal girls showed a differential of almost five inches in mean performance between 8 and 14 years, whereas the difference for the mentally retarded girls amounted to 4½ inches. In the standing broad jump the differences between the scores at 8 and 14 years were of the order of 25 inches for the normal boys and only 7 inches for the mentally retarded boys. Apparently the problem of organizing the body for the skills required in the broad jump is of a higher order than that required for the vertical jump and hence less improvement is to be expected in the broad jump with the slow learner.

Observations on the throwing behavior of normal boys and girls has universally demonstrated the marked superiority of the boys in this event at all age levels, the difference becoming greater with advancing age. As is shown in Figure 6, the same general pattern of performance holds true for the

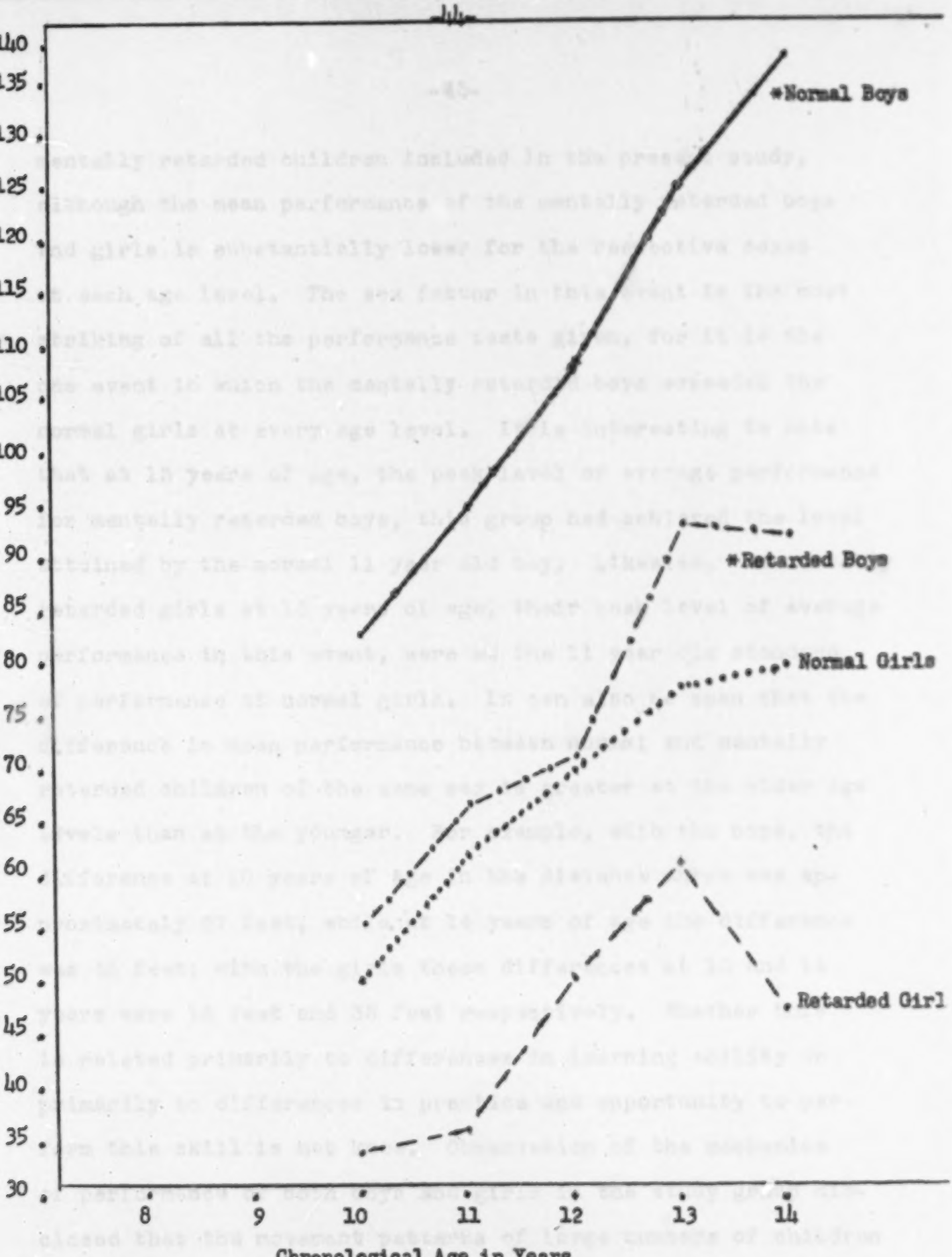

Figure 6. Comparison of Means of the Soft Ball Throw for Distance for Normal and Mentally Retarded Children by Chronological Age

*Data on Normal Boys and Girls Adapted From Neilson and Cozens (20).

mentally retarded children included in the present study, although the mean performance of the mentally retarded boys and girls is substantially lower for the respective sexes at each age level. The sex factor in this event is the most striking of all the performance tests given, for it is the one event in which the mentally retarded boys exceeded the normal girls at every age level. It is interesting to note that at 13 years of age, the peak level of average performance for mentally retarded boys, this group had achieved the level attained by the normal 11 year old boy. Likewise, the mentally retarded girls at 13 years of age, their peak level of average performance in this event, were at the 11 year old standard of performance of normal girls. It can also be seen that the difference in mean performance between normal and mentally retarded children of the same sex is greater at the older age levels than at the younger. For example, with the boys, the difference at 10 years of age in the distance throw was approximately 27 feet, while at 14 years of age the difference was 45 feet; with the girls these differences at 10 and 14 years were 16 feet and 35 feet respectively. Whether this is related primarily to differences in learning ability or primarily to differences in practice and opportunity to perform this skill is not know. Observation of the mechanics of performance of both boys and girls in the study group disclosed that the movement patterns of large numbers of children of both sexes were poor and indicated unfamiliarity with the correct manner of executing this skill.

Running Speed: The age trends for average speed of running expressed in yards per second for normal and mentally retarded boys and girls are shown in Figure 7. The typical trend of superiority of performance of the normal children over that of the mentally retarded is again demonstrated in this event. The superiority of the normal children in this event is so great that at no age level do the means of the mentally retarded children approximate the mean performance of the normal boys and girls. It should be noted that the differences between the performance levels of the sexes are in general similar for the two groups and that the slope of the performance curves are not markedly different. However, the normal girls achieve the greatest speed of running on the average at approximately 13 years of age with performance declining thereafter whereas the mentally retarded girls continue to show improvement between 12 and 14 years. The mean performance of the normal boys and girls is on the average closer at 12 than at 14 years while that of the mentally retarded is closer at 14 than at 12.

Measures of Agility: The Burpee Test, or the number of squat thrusts executed in a ten second period is presumed to be an index of general body coordination or agility. It will be noted that the normative data given in Table 8 for normal children show only modest changes with advancing age. As indicated earlier, this test did not prove to be entirely satisfactory with the slow learners due to problems of learning

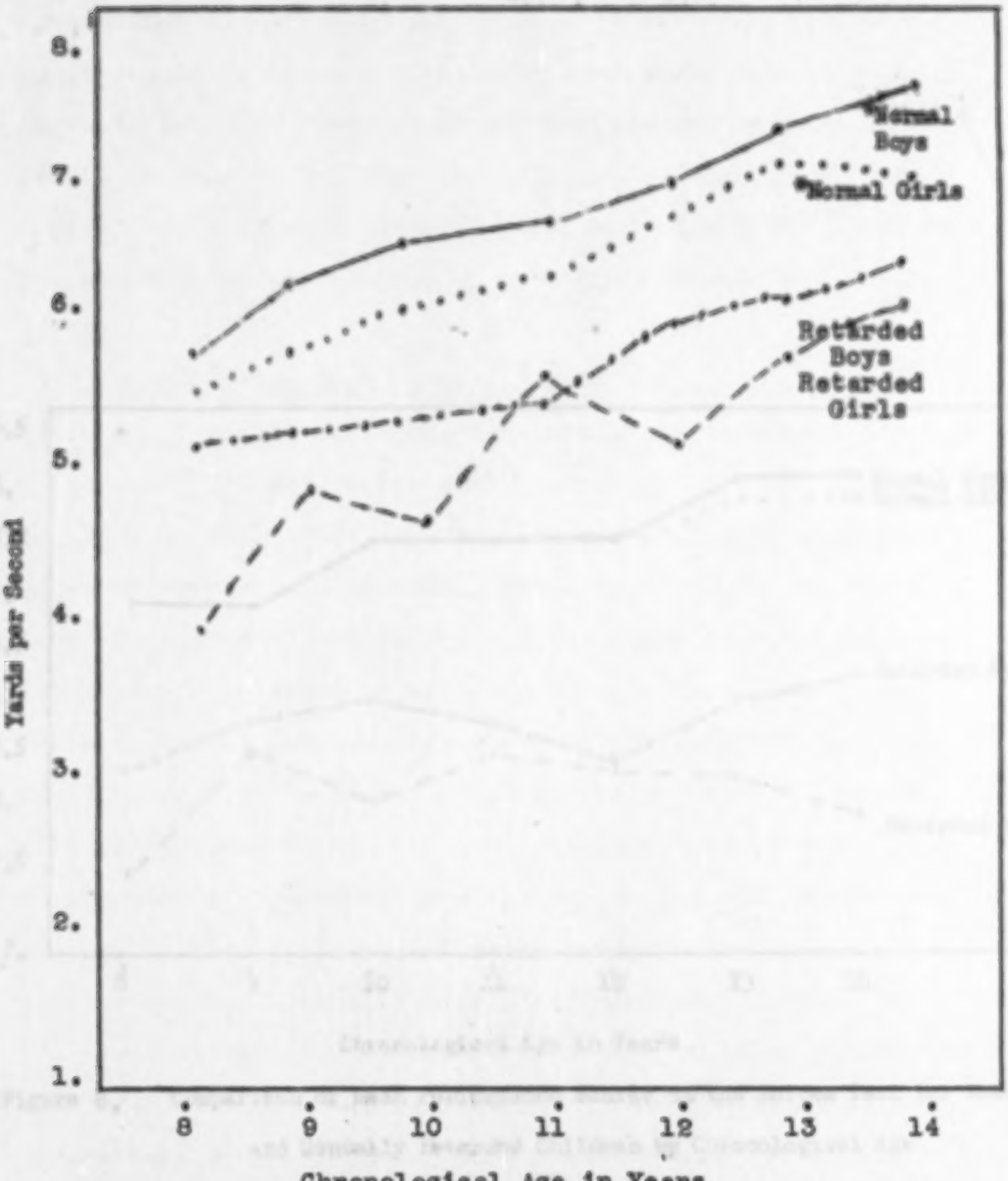

Figure 7. Speed of Running Data for Normal and Mentally Retarded Children by Chronological Age

*Data on Normal Boys and Girls Adapted from Espenschade (7), Meyer (18), and Neilson and Cozens (20).

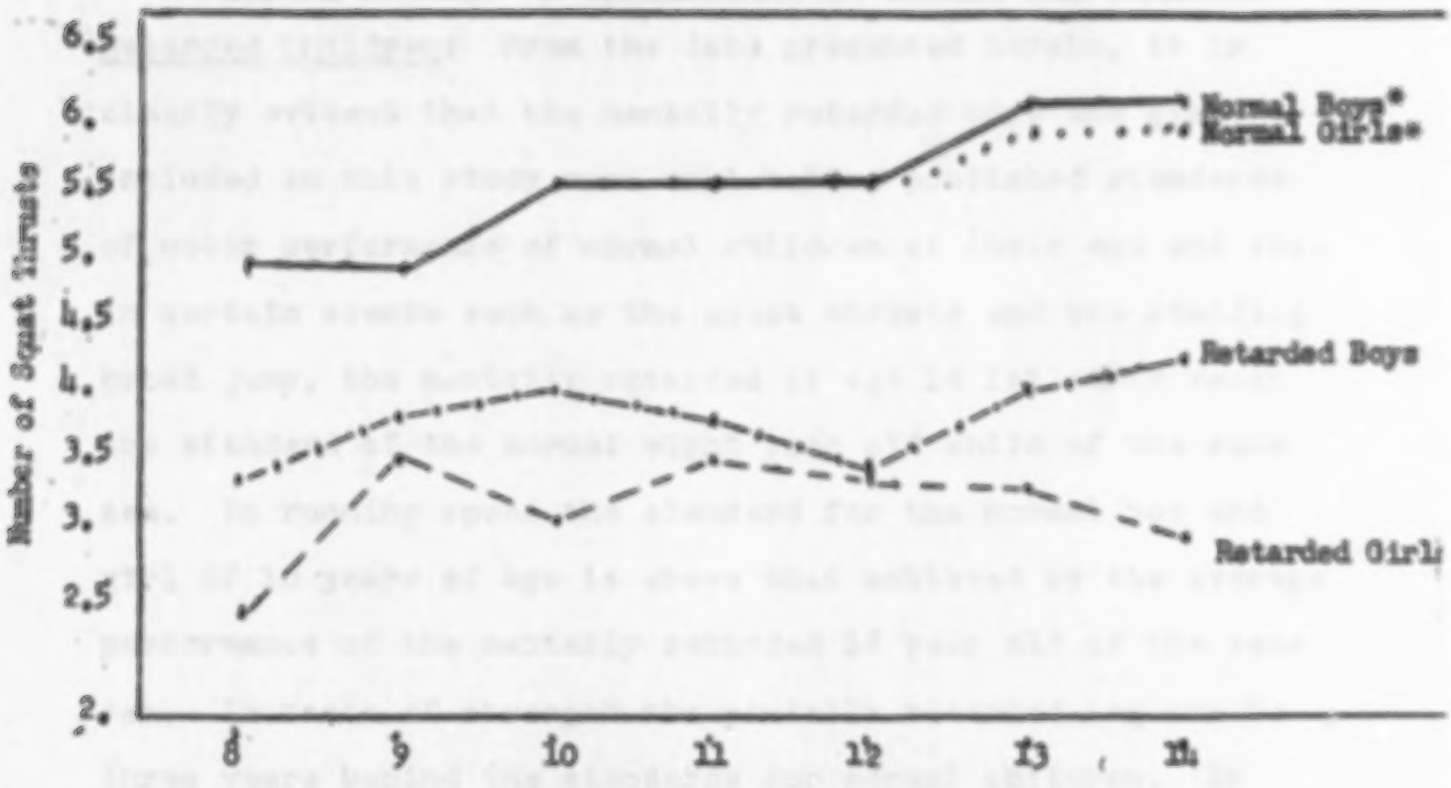

Figure 8. Comparison of Mean Performance Scores on the Burpee Test for Normal and Mentally Retarded Children by Chronological Age

*Data on Normal Boys and Girls Adapted from Carpenter (3) and McCloy (15)

the correct execution of the event. Hence, caution should be exercised in interpreting the curves presented for the mentally retarded boys and girls as given in Figure 8. Even so, it is safe to say that in agility, as measured by the Burpee Test, the slow learners were at no age level equal to the standard of performance of the normal 8 year old boy or girl.

General Summary on Performance of Normal and Mentally Retarded Children: From the data presented herein, it is clearly evident that the mentally retarded boys and girls included in this study were well behind published standards of motor performance of normal children of their age and sex. In certain events such as the squat thrusts and the standing broad jump, the mentally retarded at age 14 failed to reach the standard of the normal eight year old child of the same sex. In running speed the standard for the normal boy and girl of 10 years of age is above that achieved by the average performance of the mentally retarded 14 year old of the same sex. In tests of strength the mentally retarded lag one to three years behind the standards for normal children. In the vertical jump, a measure of explosive muscular power, the slow learner is as much as four years retarded in development when viewed in the light of published norms on normal children. These data provide rather definite evidence of the extent of motor retardation of the slow learner. However, the basic factors underlying the cause of the retardation must

await further investigation. The fact that at certain age levels the performance curves show some unusual peaks, as for example the rather consistently high performance of the 9 and 11 year old mentally retarded girls, suggests that the sample drawn at these age levels contained some rather high quality performance. This would suggest that the potential for higher levels of motor achievement is attainable with the slow learner.

Interrelationships Among Motor Functions: As pointed out earlier studies on normal human beings have shown that both gross and fine motor skills are specific in nature, although certain types of motor skills have been shown to be more highly correlated than are others. In general it has been shown that events which purport to measure the same general kind of ability tend to give reasonably high intercorrelations. The data in the present study offer the opportunity to determine whether known interrelationships among motor functions in the normal tend to hold true also for the mentally retarded. Intercorrelation tables for all variables classified according to age and sex may be found in Appendix A and may prove helpful to the reader in interpreting the discussion which follows.

Static Dynamometric Strength: Strength tests on different muscle groups with adults and adolescents give intercorrelations ranging from .50 to .90. For example, Jones (12) in a study of 72 adolescent boys found that the intercorrelations among measures of strength of grip, pull, and thrust

ranged from .72 to .83. With the mentally retarded boys at the 12, 13 and 14 year old age levels, the intercorrelations among these measures ranged from .54 to .88 with the majority of the coefficients clustering around .70. See Tables 18, 19, and 20, Appendix A. Thus, it would seem that with boys at this age level there is no great difference in the generality or specificity of strength for the two groups. At the lower age levels with the mentally retarded boys, there is greater evidence of specificity of strength with many of the correlations in the range .40 to .50. With the mentally retarded girls all correlations among the strength variables are positive, but the correlations for the two older age groups range from .25 to .79. At the lower age levels the correlations among the strength measures are still lower with several coefficients approximating .10 or less. Therefore, it is evident with the group studied that static strength as measured here is more specific in character for girls than boys, which also tends to be true with normal girls. It should, however, be noted that the correlations between right and left grip strength and between strength of pull and thrust are reasonably high for both sexes at almost all age levels. It is not surprising to find the strength of muscle groups which are closely related anatomically and functionally highly correlated.

Measures of Power: For the purposes of the present discussion speed of running is included as a power type of event along with the vertical jump, standing broad jump, and the

throw for distance. This is done because studies on normal humans have shown that the scores on these events show reasonably high intercorrelations and factor analysis studies have indicated that these events are strongly weighted with the "speed factors" (5,21). The magnitude of these intercorrelations with normal adolescents is illustrated by the findings of Espenschade (7) in which intercorrelations among power type events were reported ranging from .44 to .82 for boys and .29 to .78 for girls. The highest correlations between any two single events for both sexes were between the broad jump and the dash with coefficients of .82 and .78 for boys and girls respectively. With college men, however, Brown (2) reported a correlation of only .457 between the broad jump and the 60-yard dash. Hester (9) in a recent study on junior high school boys reported intercorrelations among the four power events ranging from .59 to .76, the latter correlation being between the broad jump and the dash. With the mentally retarded boys the intercorrelations among the four events were on the average only slightly lower than those reported on normal boys, ranging at most age levels between .35 and .80 (Appendix A). For the girls in the age groups below 12 years the majority of the correlations fell in the range of .30 to .60 which is similar to correlations reported by Espenschade (7). However, in the age groups 13 and 14 years the intercorrelations while still positive were somewhat lower. In general it would seem safe to conclude that with the sample of

mentally retarded subjects studied, the intercorrelations among the measures designed to measure power were not greatly different from that found with human beings of normal intelligence.

Measures of Balance and Agility: Many gross motor skills require elements of body balance and among these are the skills involving rapid changes in body direction. Therefore one might expect measures of balance and agility to be positively correlated. Some evidence of this is given by the work of Brown (2) in which he obtained a correlation on college men of .431 between a dodging run and a measure of body balance. With the mentally retarded boys correlations between the balance beam test and the agility run ranged from .25 to .73 and with the girls from .06 to .74 (Appendix A). For both sexes the majority of the correlations were in the range .30 to .60 indicating that these abilities are correlated in the mentally retarded in much the same way as for normal persons. It is interesting to note that the broad jump which is an event requiring considerable balance and agility as well as power gave correlations with the balance test of .31 to .79 for the mentally retarded boys and from .33 to .70 for the girls (the 14 year old group excepted). This compares favorably with the correlation reported by Brown (2) on college men of .36 between these two events.

The data on this group of mentally retarded children indicate rather strongly that the clustering of motor traits

and abilities of the mentally retarded is not greatly different from that which has been observed on normal adolescents and adults.

Intelligence and Motor Performance: Observations on normal children of school age have shown that when measures of intelligence and measures of motor skill are correlated, the coefficients are low and in many instances approximate zero. In referring to the tables of intercorrelations in Appendix A it should be noted that of the total of 84 correlations of motor performance variables with I. Q. (12 correlations at 7 age levels for each sex) 82 of the coefficients for the boys are positive. While most of the correlations are low, the fact that they are so consistently positive suggests that intelligence may play a role in the motor performance of the mentally retarded boy. With the girls the findings are less clear with many of the coefficients negative and others close to zero. Of the 84 correlations at all age levels for the girls, a total of 56 were positive and 28 negative. However, there is neither a clearcut nor consistent pattern of interrelationship of the motor performance variables with I. Q. for either boys or girls, since variables giving reasonably high correlations at one age level drop close to zero at another age. Therefore, it can be stated that although the relationship between motor performance and I. Q. tended to be positive, the intercorrelations were low and not greatly different from what one would expect to find with normal children.

Motor Performance of Institutionalized Cases: Only the findings on the motor performance tests for which data exist on both the institutionalized cases and normal pre-school children will be reported here. The data on both groups are presented in terms of mean scores so that some idea may be had of the relative levels of motor performance of the institutionalized children (Mongols and Familials) and normal pre-school children. For ease of handling the data the pre-school children were grouped according to chronological age in three age categories, namely 2.5 to 3.5 years, 3.5 to 4.5 years, and 4.5 to 5.5 years. No attempt was made to treat the data according to sex, since investigators agree that sex differences in motor performance prior to school age are insignificant. Treatment of the data in this way gave a rough approximation of the average level of motor proficiency of Mongols and Familials with mean chronological ages of 9.3 and 10.1 years respectively.

Agility Run: The following shows the mean performance of the pre-school children in the agility run and that of the Mongols and the Familials:

Pre-school Means by Chronological Age

Age Range	Score
2.5 to 3.5 yrs.	9.9 sec.
3.5 to 4.5 yrs.	7.6 sec.
4.5 to 5.5 yrs.	6.9 sec.

Mean Scores for Institutionalized Cases

Mongols	12.4 sec.
Familials	13.1 sec.

The above indicates that the performance of the institutionalized children on the agility run as measured in minimum time required to negotiate the distance is substantially inferior to that of the normal three year old child. The Mongols in particular showed a particularly awkward gait in which the lead foot in the run tended to slap the floor and the body weight tended to be retained over the trailing foot. Observation of the Mongols, suggested a good deal of caution in manuvering the body into a position where there might be a loss of balance. Although the data showed no difference in time performance on this event between Mongols and Familials, general observation indicated that the Familials moved with the greater ease.

Target Throw: The mean scores for pre-school and institutionalized children on the throw for accuracy were as follows:

Pre-school Means by Chronological Age

Age Range	Score
2.5 to 3.5 yrs.	6.5 points
3.5 to 4.5 yrs.	11.1 points
4.5 to 5.5 yrs.	13.9 points

Mean Scores for Institutionalized Cases

Mongols	6.6 points
Familials	8.1 points

For the groups observed the performance of the Mongols on the accuracy throw was at the level the average three year old whereas that of the group of Familials approached the performance of the normal four year old.

Pennies-in-the-box: This test of fine motor control was interesting to the institutionalized children, and although it required considerable concentration, it nevertheless, held the attention of almost all subjects. The following lists the mean performances (number of pennies placed in box) for both groups:

Pre-school Means by Chronological Age	
Age Range	Score
2.5 to 3.5 yrs.	7.0
3.5 to 4.5 yrs.	12.4
4.5 to 5.5 yrs.	14.7

Mean Scores for Institutionalized Cases	
Mongols	7.1
Familials	13.6

The data indicated that on this kind of fine manipulative skill the average Mongol was at about the level of the average three year old, whereas the Familial had attained the level of about the normal 4⅓ year old.

Striking with a Mallet: Striking is a skill which normal children acquire early in life, and which is performed with reasonable skill and ease prior to school age. Below are given the mean scores (ratings) for the groups on this test:

Pre-school Means by Chronological Age		
	Score	
Age Range	Pass	Fail
2.5 to 3.5 yrs.	3	3
3.5 to 4.5 yrs.	26	8
4.5 to 5.5 yrs.	20	0

Mean Scores for Institutionalized Cases		
	Score	
	Pass	Fail
Mongols	20	22
Familials	22	2

On this skill which might be considered as one involving the elements of both fine and gross motor coordination, the Mongols attained the mean level of performance of the normal three year old. The Familials on the average achieved the level of the normal five year old.

Grip Strength: While manual strength as measured by the hand dynamometer does not require much in the way of coordination, it does nevertheless demand the attention of the subject and a willingness to exert maximum effort. The averages below for both groups are based on the child's highest strength score.

Pre-school Means by Chronological Age		Mean Scores for Institutionalized Cases	
Age Range	Score		
2.5 to 3.5 yrs.	3.2 lbs.		
3.5 to 4.5 yrs.	3.8 lbs.	Mongols	3.7 lbs.
4.5 to 5.5 yrs.	5.3 lbs.	Familials	11.1 lbs.

It is interesting to note that in this test the Familials were on the average well above the level attained by the normal five year olds. The Mongols, however, were only the equivalent of the normal four year olds. It may be that the Mongols had the strength available for a greater effort, but due to lack of understanding or the unwillingness to exert energy the performance remained low. In any event, the strength of the Mongol as measured here would appear to be almost as much retarded as the other performance skills.

Stair Climbing: Observations on stair climbing behavior were made with the children ascending and descending a standard flight of stairs where a hand railing was available for use. A record was kept of the manner in which the child negotiated the flight in terms of whether the hand rail was used on the ascent or descent and in respect to the alternation of feet on successive risers. With pre-school children only the younger group used the hand rail and all youngsters alternated feet on both ascent and descent. All Mongols in the study group used the hand rail in ascending and descending the stairs. During the ascent the Mongols alternated feet, but the method of marking time on each riser was the typical pattern of the descent. The behavior of the Familials was varied, some performing in the more infantile manner of the Mongols and others showing normal performance.

SUMMARY AND CONCLUSIONS

This investigation has been concerned with describing certain motor characteristics of mentally retarded children. The subjects for the investigation included 284 mentally retarded boys and girls in special classes in the public schools of Madison and Milwaukee, Wisconsin. A battery of eleven gross motor tests was given to all subjects and observations were made on age and sex trends for each skill tested. In addition a small sample of 24 institutionalized cases of low intelligence was tested on six motor performance tests and the results compared with scores achieved by a sample of 60 pre-school children on the same tests.

In order to obtain a picture of the status of the motor development of the slow learner, comparisons were made between the motor achievement levels of the mentally retarded by age and sex with published norms on normal children. In addition the study was concerned with investigating the interrelationships among motor abilities of the mentally retarded and comparing these results with similar information on normal children. Observations were also made on the relationship between intelligence and the motor abilities of the mentally retarded child. Through an exploratory study with a small sample of institutionalized cases, six motor performance tests were described and data were given on the approximate level of motor ability of this group as compared to normal pre-school children.

The reliabilities of all measures used with the mentally retarded children in the public schools were sufficiently high for analysis of grouped data. In fact the reliability coefficients on all strength and motor performance data compared favorably with published reliabilities on the same test with normal children. The findings indicated that the age trends in strength for each sex followed approximately the same pattern as that for normal children, although at a lower level at every age. On the power measures (standing broad jump, vertical jump and the distance throw) the general pattern by age and sex was similar to that for normal children, although in the standing broad jump in particular the differences between age groups for both sexes, were markedly different than those reported on normal children. In running speed, balance and agility, the differences between the levels of performance of the mentally retarded by age and sex followed the same general pattern observed on normal children.

Direct quantitative comparisons between the motor proficiency scores of the mentally retarded and published data on normal children resulted in more definite conclusions. In general, it can be stated that with the mentally retarded children studied, the means of both boys and girls on most measures were two to four years behind the published age norms of normal children. Furthermore the discrepancy between the normal and the mentally retarded tended to increase with each advancing age level. With the skills which may be assumed to

be of a more complex nature involving less in the way of natural or "racial" movement patterns (such as the standing broad jump, the squat thrusts and the distance throw) the discrepancy with advancing age was exaggerated.

Apparently motor functions cluster together in the mentally retarded much as has been observed with normal humans for when the intercorrelations among scores on the specific motor tests were examined the interrelationships were approximately of the same order as for persons in the normal range of intelligence. While most of the intercorrelations among tests purporting to measure similar gross motor functions were in the range .40 to .70, the size of these coefficients is sufficient to indicate that these abilities tend to cluster in the mentally retarded much as is seen in the normal.

The findings of the study clearly demonstrated that intelligence as measured by standardized intelligence tests was positively correlated with most of the motor performance tests, although the coefficients were too low to indicate that intelligence as such influenced the level of performance of the mentally retarded. The size of the correlations found with the mentally retarded were similar to the coefficients reported on normal children between motor and mental tests.

Data on the motor proficiency of the institutionalized cases demonstrated that the motor achievement of these subjects as measured by six motor tests tended to fall in the performance range of normal three and four year old children.

In general the Mongols performed more poorly than the Familials and only in manual strength did the mean performance of the institutionalized cases (Familial) exceed the norms of the pre-school children.

In conclusion it can be stated that the mentally retarded children included in this investigation were markedly inferior in all motor performance tests and that with advancing age level the deviations from the normal tended to become greater. However, the general pattern of change by age and sex was similar to that reported on normal children, as were the inter-correlations among the specific motor tests. Although the findings would indicate that the poor quality of motor performance was a function of low intelligence, the relationship of measures of intelligence to the motor performance test scores were similar to correlations obtained between these variables on normal humans. The great differences in motor proficiency between the normal and the mentally retarded as demonstrated here clearly shows that the degree of motor retardation of these children is perhaps greater than had been previously supposed.

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APPENDIX A

Table 14. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 7-6 to 8-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.27															
3 Wt.	.07	.66														
4 I.Q.	.41	-.03	-.24													
5 St. Brd. Jump	.48	-.08	-.49	.36												
6 35 Yd. Dash	-.20	-.06	.35	-.24	-.87											
7 30 Yd. Dash	-.25	.04	.49	-.25	-.88	.93										
8 Vertical Jump	.36	.01	-.41	.35	.91	-.86	-.83									
9 Left Grip	.29	.44	.36	.21	.44	-.63	-.52	.48								
10 Right Grip	.29	.58	.54	.06	.36	-.50	-.39	.44	.92							
11 Push	.23	.03	-.09	.24	.39	-.60	-.57	.42	.56	.33						
12 Pull	.21	.05	.11	.26	.35	-.54	-.49	.26	.58	.43	.82					
13 Ball Throw	.15	-.10	-.40	.47	.57	-.43	-.47	.45	-.07	.00	.07	.20				
14 Balance Beam	.30	-.03	-.54	.46	.79	-.75	-.71	.66	.26	.09	.51	.50	.59			
15 Squat Thrust	-.11	-.59	-.55	.65	.35	-.32	-.39	.33	.16	-.08	.28	.28	.29	.35		
16 Agility Run	-.33	.20	.53	-.50	-.83	.79	.72	-.79	-.27	-.13	-.50	-.37	-.54	-.73	-.42	

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Table 15. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 8-6 to 9-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	.21															
3	Wt.	.34	.69														
4	I. Q.	-.24	.20	-.04													
5	St. Brd. Jump	.22	.25	.13	.47												
6	35 Yd. Dash	.22	-.02	-.04	-.29	-.42											
7	30 Yd. Dash	-.11	.02	.04	-.46	-.57	.90										
8	Vertical Jump	.05	.02	-.04	.40	.49	-.58	-.67									
9	Left Grip	.08	.28	.29	.54	.55	-.29	-.39	.22								
10	Right Grip	.02	.39	.29	.56	.69	-.27	-.44	.38	.86							
11	Push	.19	.27	.26	.38	.64	-.33	-.51	.36	.50	.59						
12	Pull	.21	.39	.38	.39	.54	-.35	-.46	.43	.61	.66	.76					
13	Ball Throw	.38	.13	.13	.45	.61	-.64	-.72	.52	.38	.40	.69	.66				
14	Balance Beam	.10	-.31	.07	.21	.54	-.59	-.59	.53	.54	.48	.28	.27	.32			
15	Squat Thrust	.01	-.26	-.28	.27	.42	-.14	-.39	.36	.15	.20	.21	.07	.41	.11		
16	Agility Run	-.32	.02	-.05	-.22	-.42	.75	.73	-.66	-.25	-.27	-.37	-.26	-.55	-.60	-.31	

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Table 16. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 9-6 to 10-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	.35															
3	Wt.	.52	.33														
4	I. Q.	-.08	.25	-.10													
5	St. Brd. Jump	-.30	-.00	-.48	.44												
6	35 Yd. Dash	.23	-.11	.24	-.45	-.45											
7	30 Yd. Dash	.41	-.02	.48	-.31	-.54	.89										
8	Vertical Jump	-.22	.09	-.42	.43	.62	-.69	-.67									
9	Left Grip	.08	.15	-.08	.36	.23	-.41	-.34	.23								
10	Right Grip	-.07	.03	.12	.24	.10	-.35	-.26	.11	.76							
11	Push	-.13	.28	-.29	.61	.54	-.58	-.52	.50	.46	.41						
12	Pull	-.14	.31	-.14	.57	.54	-.43	-.42	.31	.49	.48	.82					
13	Ball Throw	.09	.31	-.06	.49	.34	-.48	-.41	.27	.61	.39	.38	.53				
14	Balance Beam	-.32	.06	-.47	.44	.70	-.56	-.56	.45	.45	.29	.57	.62	.48			
15	Squat Thrust	-.21	.07	-.32	.38	.37	-.66	-.59	.78	.31	.11	.32	.13	.37	.29		
16	Agility Run	.19	-.15	.46	-.26	-.35	.55	.52	-.61	-.27	-.05	-.42	-.31	-.42	-.53	-.48	

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Table 17. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 10-6 to 11-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.29															
3 Wt.	.30	.51														
4 I. Q.	-.14	-.29	-.07													
5 St. Brd. Jump	.35	-.08	-.16	.22												
6 35 Yd. Dash	-.35	-.10	-.06	-.21	-.57											
7 30 Yd. Dash	-.16	-.12	-.02	-.21	-.52	.90										
8 Vertical Jump	.17	.02	.16	.41	.39	-.38	-.43									
9 Ieft Grip	.34	.19	.51	.33	.23	-.42	-.33	.54								
10 Right Grip	.35	.29	.48	.27	.34	-.53	-.48	.58	.90							
11 Push	.36	.13	.41	.38	.47	-.34	-.24	.39	.55	.63						
12 Pull	.43	.08	.41	.31	.57	-.51	-.44	.50	.70	.74	.86					
13 Ball Throw	.31	.17	.25	.14	.47	-.55	-.47	.62	.30	.40	.47	.58				
14 Balance Beam	-.12	-.48	-.30	.37	.40	-.13	-.20	.26	.21	.13	.03	.26	.11			
15 Squat Thrust	.02	-.08	-.47	.18	.31	-.18	-.01	.23	.11	.23	.08	.04	.04	.08		
16 Agility Run	-.28	.06	.23	-.20	-.55	.64	.53	-.37	-.31	-.51	-.24	-.42	-.47	-.25	-.61	

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Table 18. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 11-6 to 12-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	.21															
3	Wt.	.51	.73														
4	I. Q.	.16	.05	.02													
5	St. Brd. Jump	-.03	-.29	.13	.50												
6	35 Yd. Dash	-.37	.13	-.20	.24	-.13											
7	30 Yd. Dash	-.39	.09	-.23	.28	-.10	.99										
8	Vertical Jump	-.33	-.26	-.34	.08	.55	.18	.13									
9	Left Grip	.11	.51	.47	.30	.21	.21	.16	.38								
10	Right Grip	.12	.43	.46	.38	.32	.14	.11	.36	.93							
11	Push	.20	.43	.52	.30	.28	.01	-.02	.13	.72	.74						
12	Pull	.23	.47	.54	.25	.28	-.08	-.07	.08	.64	.60	.88					
13	Ball Throw	.08	.13	.11	.63	.40	.25	.27	.31	.60	.68	.53	.49				
14	Balance Beam	-.08	-.13	-.20	.48	.31	.45	.44	.31	.45	.46	.49	.33	.55			
15	Squat Thrust	.12	-.14	-.05	.38	.54	.26	.06	.21	.08	.35	.07	.01	.38	.15		
16	Agility Run	.37	.07	.15	-.47	-.47	-.08	-.09	-.39	-.41	-.43	-.26	-.27	-.61	-.27	-.23	

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Table 19. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 12-6 to 13-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.01															
3 Wt.	-.04	.63														
4 I. Q.	.15	.26	.35													
5 St. Brd. Jump	-.20	.24	.15	-.03												
6 35 Yd. Dash	-.01	-.04	-.17	-.31	-.40											
7 30 Yd. Dash	-.13	-.02	-.15	-.45	-.36	.93										
8 Vertical Jump	-.17	.08	-.00	.13	.36	-.55	-.52									
9 Left Grip	-.12	.44	.65	.41	.29	-.39	-.38	.51								
10 Right Grip	-.04	.55	.67	.43	.35	-.46	-.48	.51	.95							
11 Push	-.03	.13	.48	.16	.26	-.44	-.45	.51	.76	.77						
12 Pull	-.07	.14	.41	.37	.29	-.50	-.51	.51	.80	.80	.80					
13 Ball Throw	.03	.01	.30	.15	.53	-.56	-.56	.57	.67	.69	.80	.69				
14 Balance Beam	.06	.10	.23	.43	.41	-.78	-.75	.27	.27	.41	.31	.46	.40			
15 Squat Thrust	-.10	.16	.23	.07	.41	-.51	-.56	.54	.41	.49	.46	.38	.44	.26		
16 Agility Run	-.07	.22	-.08	-.24	-.32	.85	.81	-.51	-.33	-.33	-.40	-.42	-.63	-.65	-.49	

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Table 20. Intercorrelations of Motor Performance Scores of Mentally Retarded Boys in the Age Group 13-6 to 14-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.14															
3 Wt.	-.10	.81														
4 I.Q.	-.08	.08	-.02													
5 St. Brd. Jump	-.05	.05	-.19	.45												
6 35 Yd. Dash	-.05	-.23	-.18	-.35	-.45											
7 30 Yd. Dash	-.09	-.28	.25	-.33	-.41	.94										
8 Vertical Jump	.13	.28	.03	.15	.49	-.44	-.45									
9 Left Grip	.15	.48	.31	.25	.53	-.47	-.50	.63								
10 Right Grip	.06	.52	.38	.32	.40	-.42	-.40	.54	.87							
11 Push	.25	.35	.14	.29	.36	-.46	-.53	.50	.73	.54						
12 Pull	.09	.45	.31	.37	.34	-.54	-.48	.58	.69	.65	.64					
13 Ball Throw	.02	.35	.19	.44	.56	-.61	-.61	.46	.50	.50	.58	.46				
14 Balance Beam	-.17	.18	.08	.56	.47	-.65	-.63	.31	.29	.20	.32	.27	.42			
15 Squat Thrust	.14	-.04	-.24	.47	.43	-.22	-.21	.35	.21	.01	.47	.37	.39	.31		
16 Agility Run	-.12	.15	.22	-.27	-.49	.59	.55	-.40	-.14	.04	-.35	-.38	-.42	-.49	-.52	

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Table 21. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 7-6 to 8-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	.11															
3	Wt.	.09	.74														
4	I. Q.	.37	.40	.22													
5	St. Brd. Jump	-.06	.11	-.12	-.01												
6	35 Yd. Dash	-.20	.35	.38	-.12	-.65											
7	30 Yd. Dash	-.06	.41	.38	.05	-.52	.93										
8	Vertical Jump	-.08	.10	-.03	-.21	.80	-.54	-.61									
9	Left Grip	-.17	.57	.40	.37	.39	.13	.15	.23								
10	Right Grip	-.10	.45	.21	.50	.48	-.11	-.07	.18	.94							
11	Push	.20	-.21	-.04	.22	.27	-.63	-.57	.03	.18	.27						
12	Pull	.21	.09	-.12	.10	.54	-.52	-.50	.37	.45	.55	.71					
13	Ball Throw	-.05	.33	.16	-.11	.40	-.12	-.00	.43	-.16	-.21	-.28	-.06				
14	Balance Beam	-.10	-.02	-.24	-.35	.66	-.49	-.61	.76	.32	.37	.32	.76	.11			
15	Squat Thrust	-.04	-.16	.08	-.03	.35	-.63	-.62	.28	-.14	.05	.42	.33	.02	.26		
16	Agility Run	-.09	.18	.09	.10	-.70	.90	.87	-.68	.07	-.08	-.56	-.52	-.32	-.58	-.71	

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Table 22. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 8-6 to 9-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	-.03															
3 Wt.	.12	.15														
4 I. Q.	-.17	.20	-.56													
5 St. Brd. Jump	-.08	.01	-.55	.54												
6 35 Yd. Dash	.38	-.27	.05	-.33	-.46											
7 30 Yd. Dash	.23	-.26	.03	-.37	-.56	.92										
8 Vertical Jump	-.25	.25	-.30	.58	.49	-.51	-.51									
9 Left Grip	.11	.35	.10	.33	.43	-.46	-.54	.30								
10 Right Grip	.25	.21	-.13	.36	.47	-.26	-.36	.30	.83							
11 Push	.11	-.25	.13	-.00	.06	-.04	-.01	.21	.05	.01						
12 Pull	.23	-.14	.00	-.09	.24	.21	.10	.10	.21	.12	.44					
13 Ball Throw	.11	.18	-.36	.24	.31	-.34	-.33	.50	.44	.42	-.03	.19				
14 Balance Beam	-.47	.40	-.22	.38	.35	-.57	-.50	.40	.37	.12	.09	.04	.27			
15 Squat Thrust	-.12	.07	-.34	.47	.55	-.54	-.47	.63	.12	.33	.26	-.03	.17	.30		
16 Agility Run	.03	-.11	.68	.71	-.56	.37	.38	-.65	-.38	-.52	.03	-.06	-.60	-.29	-.55	

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Table 23. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 9-6 to 10-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.09															
3 Wt.	-.43	.51														
4 I. Q.	.19	.37	.11													
5 St. Brd. Jump	.05	-.56	-.67	-.26												
6 35 Yd. Dash	-.25	.15	.58	-.02	-.45											
7 30 Yd. Dash	-.37	.15	.63	-.04	-.46	.98										
8 Vertical Jump	.37	.04	.71	.20	.58	-.57	-.62									
9 Left Grip	.39	.21	-.38	.12	.44	-.28	-.27	.61								
10 Right Grip	.31	.09	-.47	.07	.54	-.36	-.36	.56	.90							
11 Push	.59	-.38	-.69	-.03	.57	-.48	-.52	.57	.42	.38						
12 Pull	.31	-.39	-.63	-.03	.56	-.48	-.49	.53	.33	.27	.87					
13 Ball Throw	-.12	-.12	-.31	.17	.21	-.15	-.23	.44	-.34	-.23	-.10	-.04				
14 Balance Beam	.36	-.06	-.74	-.08	.60	-.68	-.67	.76	.57	.70	.38	.21	.33			
15 Squat Thrust	.48	.11	-.49	.24	.52	-.33	-.34	.73	.82	.80	.57	.37	.00	.72		
16 Agility Run	-.26	-.10	.58	-.15	-.29	.86	.88	-.72	-.23	-.35	-.37	-.33	-.44	-.74	-.41	

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Table 24. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 10-6 to 11-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.38															
3 Wt.	.18	.43														
4 I. Q.	.10	-.02	-.04													
5 St. Brd. Jump	-.11	-.73	-.11	.24												
6 35 Yd. Dash	-.14	.23	.01	-.13	-.60											
7 30 Yd. Dash	-.29	.14	-.04	.00	-.51	.81										
8 Vertical Jump	-.01	-.40	-.17	.31	.67	-.57	-.73									
9 Left Grip	.07	.18	.55	.06	.38	-.45	-.40	.35								
10 Right Grip	-.08	.07	.54	.33	.41	-.52	-.34	.43	.83							
11 Push	-.01	-.03	.40	.22	.61	-.64	-.45	.27	.66	.62						
12 Pull	.14	.24	.34	.38	.27	-.36	-.20	.05	.34	.43	.77					
13 Ball Throw	.02	-.31	.18	.22	.72	-.50	-.52	.68	.50	.66	.53	.52				
14 Balance Beam	-.24	-.56	.05	.14	.70	-.75	-.55	.49	.19	.38	.60	.22	.40			
15 Squat Thrust	.25	.25	-.26	.29	.00	-.21	-.16	.44	.26	.19	.00	-.05	.05	-.09		
16 Agility Run	-.06	.26	-.29	-.21	-.66	.37	.37	-.57	-.75	-.61	-.56	-.35	-.72	-.25	-.26	

Table 25. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 11-6 to 12-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	.16															
3	Wt.	-.09	.16														
4	I. Q.	.46	.16	-.20													
5	St. Brd. Jump	.01	.11	.04	.50												
6	35 Yd. Dash	-.21	-.19	-.43	-.63	-.56											
7	30 Yd. Dash	-.35	-.28	-.42	-.72	-.56	.93										
8	Vertical Jump	.42	.22	.29	.36	.17	-.56	-.65									
9	Left Grip	-.06	-.01	.55	.09	.31	-.24	-.36	.16								
10	Right Grip	.22	.11	.64	.16	.40	-.41	-.54	.29	.88							
11	Push	-.00	.07	.54	.06	.52	-.41	-.31	.10	.27	.38						
12	Pull	-.10	.07	.57	.17	.55	-.40	-.44	.14	.48	.56	.47					
13	Ball Throw	-.09	.10	.30	.49	.36	-.58	-.48	.40	.17	.04	.50	.33				
14	Balance Beam	.23	-.15	-.40	.57	.38	-.11	-.23	.31	.07	.04	-.08	-.14	.29			
15	Squat Thrust	.05	-.20	-.28	.10	.36	.08	.01	-.27	.41	.30	-.07	-.13	-.29	.27		
16	Agility Run	-.28	-.27	-.28	-.59	-.38	.71	.80	-.58	-.40	-.46	-.12	-.45	-.33	.06	.04	

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Table 26. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 12-6 to 13-5 Years

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age																
2	Ht.	-.15															
3	Wt.	-.26	.67														
4	I. Q.	-.10	.06	-.16													
5	St. Brd. Jump	.26	-.38	-.40	-.38												
6	35 Yd. Dash	-.70	-.15	.08	.07	-.31											
7	30 Yd. Dash	-.60	-.14	.35	.03	-.43	.74										
8	Vertical Jump	.12	.23	.17	-.33	-.02	-.55	-.16									
9	Left Grip	.27	.44	.05	.08	.19	-.60	-.45	.21								
10	Right Grip	.28	.39	.10	-.04	.28	-.64	-.45	.26	.96							
11	Push	.04	-.12	.08	.19	-.01	-.18	.00	.20	.19	.16						
12	Pull	-.01	.34	.29	-.01	-.15	-.31	-.14	.36	.50	.49	.78					
13	Ball Throw	.37	.23	-.04	-.10	.46	-.49	-.59	.34	.31	.32	.43	.44				
14	Balance Beam	-.05	-.27	-.21	.04	.33	-.16	-.24	.32	-.31	-.25	.28	-.11	.37			
15	Squat Thrust	.15	-.42	-.58	.32	.07	-.04	-.23	-.06	-.09	-.17	.11	-.06	.03	.02		
16	Agility Run	-.65	.09	.40	.27	-.40	.67	.65	-.59	-.25	-.23	-.23	-.27	-.73	-.34	-.25	

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Table 27. Intercorrelations of Motor Performance Scores of Mentally Retarded Girls in the Age Group 13-6 to 14-5 Years

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Age																
2 Ht.	.26															
3 Wt.	.08	.84														
4 I. Q.	.01	-.03	.09													
5 St. Brd. Jump	.04	.38	.58	-.02												
6 35 Yd. Dash	.05	-.11	-.11	.02	-.33											
7 30 Yd. Dash	.00	.06	-.04	-.03	-.32	.96										
8 Vertical Jump	.05	-.06	.15	-.10	.22	-.28	-.26									
9 Left Grip	-.05	.28	.48	.56	.32	-.57	-.48	.27								
10 Right Grip	-.04	.36	.52	.44	.51	-.74	-.65	.17	.92							
11 Push	-.09	-.11	.13	-.02	.42	-.47	-.51	.80	.25	.31						
12 Pull	-.05	.00	.33	.28	.42	-.61	-.58	.72	.67	.68	.79					
13 Ball Throw	-.25	.06	.19	.39	.30	-.55	-.57	.40	.53	.58	.69	.71				
14 Balance Beam	-.08	-.45	-.40	.15	.01	-.57	-.69	.37	.28	.26	.60	.40	.53			
15 Squat Thrust	-.10	-.06	.19	-.01	.29	-.24	-.28	.63	.10	.17	.88	.58	.58	.49		
16 Agility Run	-.04	.14	.01	-.23	-.28	.68	.77	-.25	-.48	-.62	-.42	-.62	-.50	-.42	-.19	

APPENDIX B

Description of Test Given to the Institutionalized Childrem

Agility Run

1. Purpose: To determine the time required for the agility run.
2. Equipment: An area 25 feet long. A blanket for subject to lie on and a stop watch. A small object (ball) for subject to recover placed on a chair at a distance of 15 feet from the starting line.
3. Instructions: Instruct the subject to lie flat on his back feet facing the chair holding the object, and at the starting signal get up quickly, run to the object, pick it up and return to the starting line as rapidly as possible. Time is taken from the signal "go" until subject returns to starting point.
4. Scoring: Use three trials and record score in seconds.

APPENDIX B

Target Throw

(Modification of Lincoln-Oseretsky Test Item)

1. Purpose: To determine the accuracy of throwing a ball at a target placed ten feet from the subject.

2. Equipment: Target, two tennis balls.

3. Instructions: Instruct subject to throw balls at the center of the target with an overarm throw. If necessary demonstrate the throw and give subject a few preliminary trials to insure understanding. Subject throws three times at the target. Record all scores.

4. Scoring: Points will be given as follows:

10	center circle
8	second ring
6	third ring
4	hit on target
2	near hit on target
0	complete miss

APPENDIX B

Pennies-In-The-Box

(Modification of Lincoln-Oseretsky Test Item)

1. Purpose: To place as many pennies as possible (one at a time) in a box 10 cm x 10 cm x 3 cm within a period of fifteen seconds.

2. Equipment: A box 10 cm x 10 cm x 3 cm, 20 pennies, a table and chair and a stop watch.

3. Instructions and Administration: The subject should be seated at a table with the pennies within easy reach. The pennies should be placed in two rows two inches apart with the first row two inches from the box and with approximately 1/4 inch separating the coins. Instruct subject to place, at the signal "go", the pennies in the box one at a time using one hand only. A demonstration of the test and a practice trial should be given to be certain that the subject understands the test. At the end of fifteen seconds the command "stop" is given and the results recorded. The child may use either hand, but the same hand must be used on all three trials.

4. Scoring: The child's score on each trial is the number of pennies placed in the box in the 15 second time interval.

Hand used:

Left _____

Right _____

APPENDIX B

Striking With a Mallet

1. **Purpose:** To strike a table top forcefully several times with a mallet, without superfluous movement, such as clenching the teeth, wrinkling the forehead, or pressing the lips together.
2. **Equipment:** A table and a mallet.
3. **Instructions:** Instruct the subject to strike a table top forcefully several times with the mallet, first with the right hand and then the left. A demonstration may be necessary.
4. **Administration:** Allow three trials for each hand.
5. **Scoring:** The test is negative when accompanied by any superfluous movements such as clenching the teeth, wrinkling the forehead, or pressing the lips together tightly. When the test is executed by one of the hands only, it is considered negative, but the hand which performed successfully should be indicated on the score sheet.

Three trials for each hand permitted

Left hand	+	−
Trial #1		
#2		
#3		

Right hand	+	−
Trial #1		
#2		
#3		

APPENDIX B

Hand Dynamometer Test

1.	Purpose:	To measure grip strength of the children by means of the hand dynamometer.
2.	Equipment:	A Stoetling hand dynamometer.
3.	Instructions and Administration:	The subject is seated in a chair with the elbow of the member being tested resting on the knee. The elbow is flexed to an angle of approximately 45 degrees with the subject holding the dynamometer in the palm of the hand. The entire procedure is demonstrated to the subject so that some understanding is gained concerning the "squeezing" which is required. Three trials are given with 10 seconds between trials.
4.	Scoring:	Record the value from the scale at which the pointer stops. Record all trials.

APPENDIX B

Stair Climbing

1. Purpose: To observe the manner in which the subject ascends and descends a flight of stairs.

2. Equipment: A stairway.

3. Instructions: Instruct the subject to walk up the stairs, turn around, and descend.

4. Scoring: Record the manner in which the subjects ascend, e. i., alternating feet or marking time on a riser. Follow same procedure in observing the descent.

	Up	Down
Alternating feet	_____	_____
Marking time on a riser	_____	_____